(Established 1832).

AMERICAN ENGINEER AND RAILROAD JOURNAL.

APRIL, 1907

SOUTH LOUISVILLE SHOPS.*

LOUISVILLE AND NASHVILLE RAILROAD.

V.

SMITH SHOP.†

Location.—The blacksmith shop lies alongside the machine and erecting shop, the east end being directly opposite one end of the freight car repair shop and alongside the traveling crane. (For plan of layout see page 208, June, 1906.) Finished material is delivered by the shop crane to the traveling crane for distribution, except in such instances as it may be more convenient to truck it to the machine shop. Raw material is delivered and stored at the north side of the building. One of the material tracks enters and extends across the shop and material for the bolt shop is unloaded from the car to the rack inside of the shop. Finished material for shipment to outside points may also be loaded on cars on this track.

CENTRAL BAY OF SMITH SHOP.—SOUTH LOUISVILLE SHOPS.

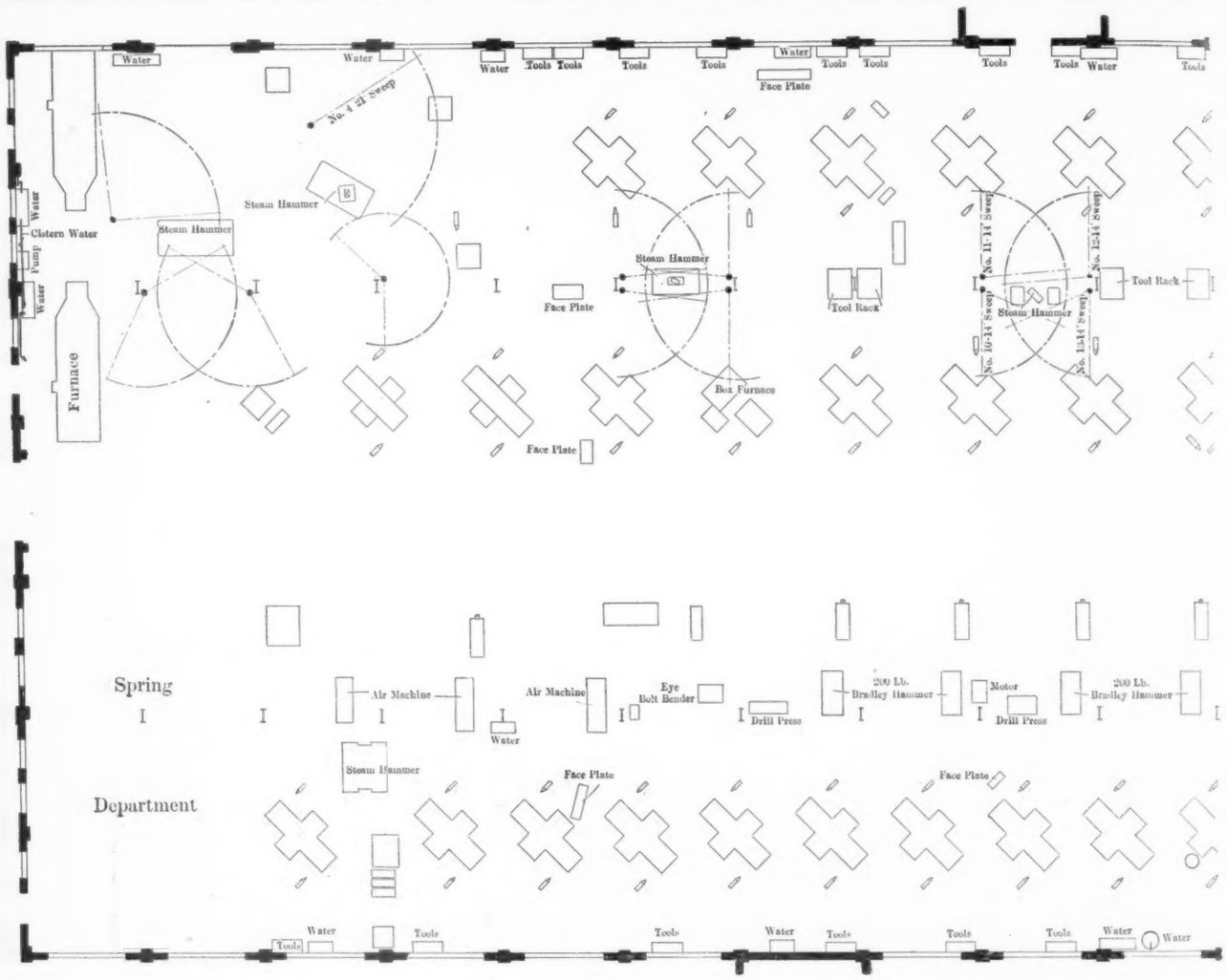
Building.—The blacksmith shop is a steel frame brick building 150 ft. 9 in. x 402 ft. 1 in., outside dimensions. It has a floor area of approximately 60,000 sq. ft. Smith shops which serve both car and locomotive departments ordinarily have from 20,000 to 40,000 sq. ft. of floor area, but at the South Louisville shops a greater space is required because of the large amount of new equipment, both car and locomotive, which is constructed. The building is divided by two rows of columns into three bays, the center one of which is 70 ft. wide, center to center of columns. The distance from the floor to the underside of the roof truss of this bay is 35 ft. 3 in., and it is served by a 10-ton Niles traveling crane. As nearly as we can find this is the first railroad blacksmith shop in this country to be equipped with a traveling crane. The cage for the crane operator is only 10 ft. from the floor, in order to keep him away from any gases which may gather near the roof. The monitor is about 35 ft. wide and is almost as long as the building. The side windows in the center bay are about 16 ft. high and extend the entire length of the building. These permit the smoke to pass out. There are no hoods or smokestacks over the forges. Two years' experience has proved that smoke hoods are not necessary, as the shop is clear of smoke and gas at all times. The sheet copper ventilators, 3 ft. in diameter, are spaced about 40 ft. apart.

The two side bays are each about 40 ft. wide and the underside of the roof truss is 20 ft. above the floor. On the side of the building nearest the machine shop are two additions, each about 20 ft. sq., one containing the apparatus for heating and circulating hot air for heating the shop and the other the blast fans. On the other side of the building is a two-story addition about 22 x 60 ft., inside dimensions, containing wash bowls and lockers. These three additions have granitoid floors; the main shop floor is of clay.

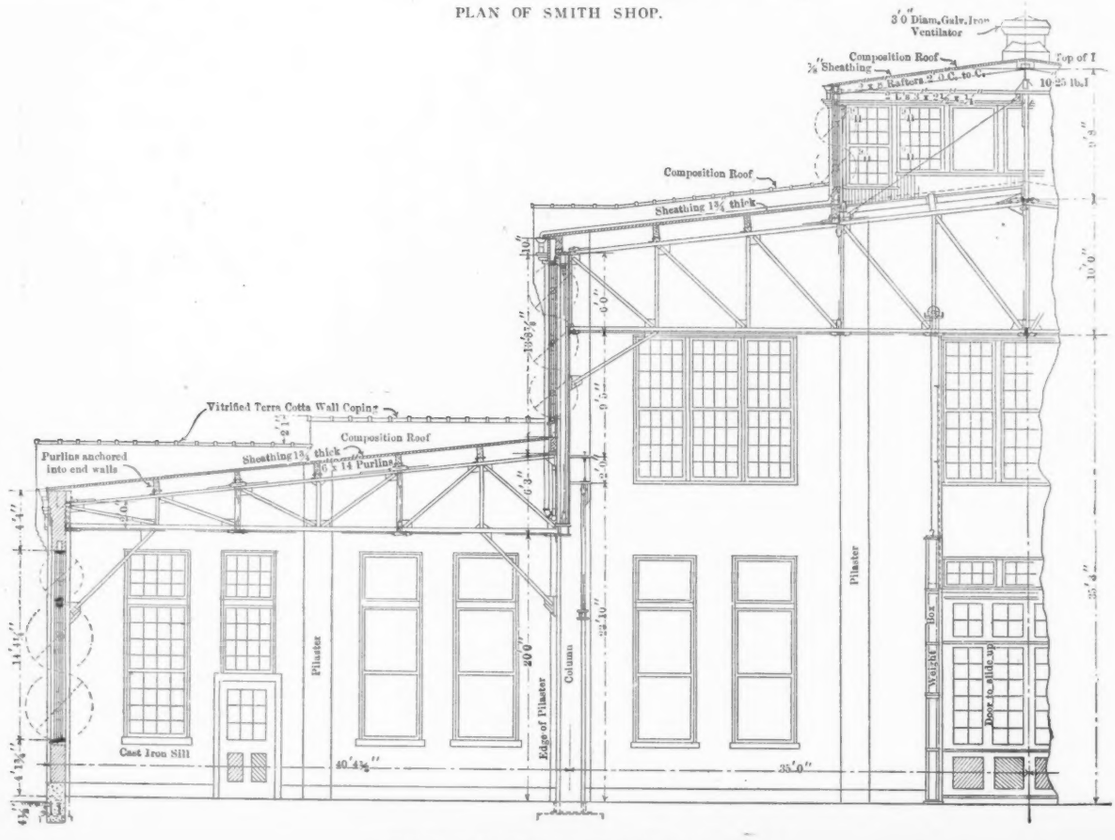
The general construction of the building is quite clearly shown on the accompanying drawings. The concrete foundations rest on creosoted piles. The roof purlins are fastened to the trusses by 4 x 3 x ⅜-in. angle clips, which are riveted to the trusses and bolted to the purlins. The roof is covered with a composition roofing. All the windows are hung on pivoted sash, except a few of those at the ends of the building and where the diagonal braces interfere. The large amount of head

* The previous articles in this series were: General Plan and Operation, page 209, June, 1906; Car Department, page 378, October, 1906; Power House, page 419, November, 1906; Foundry, and Pattern Shop and Storage Building, page 50, February, 1907.

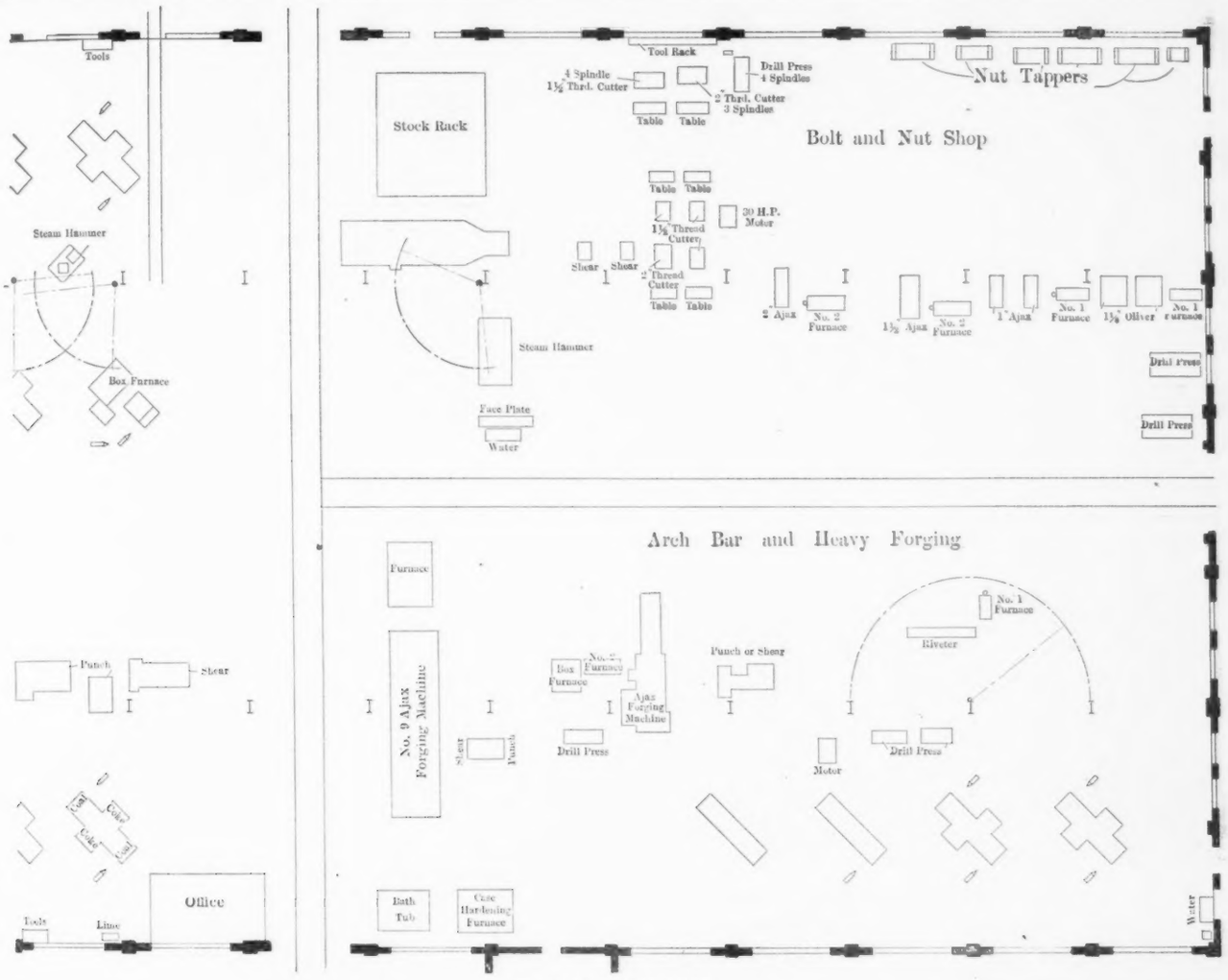
† The blacksmith shops which have recently been described in this journal are as follows: Lake Shore & Michigan Southern Ry., Collinwood, Building Construction, page 302, October, 1902; Floor Plan, page 374, December, 1902; List of Large Tools, page 42, February, 1903; Oil Furnaces and the Oil Storage and Delivery System, page 334, September, 1903. Pittsburg & Lake Erie R. R., McKee's Rocks, Building Construction, page 24, January, 1904; Equipment and Operation, page 382, October, 1904. Canadian Pacific Ry., Angus, Building Construction, page 1, January, 1905, and page 37, February, 1905; Equipment and Operation, page 363, October, 1905. Chicago, Rock Island & Pacific Ry., Moline, Building Construction, page 395, November, 1905. There was also an article by Mr. R. H. Soule on the general design and arrangement of smith shops, page 205, June, 1903.



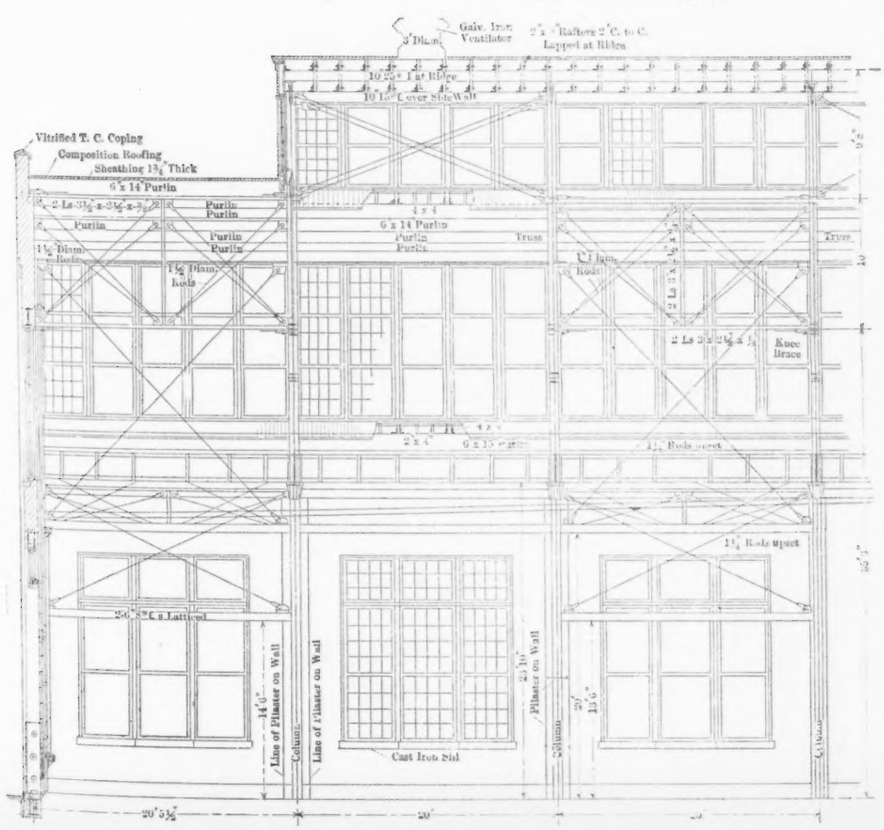
PLAN OF SMITH SHOP.



HALF CROSS-SECTION OF SMITH SHOP.



PLAN OF SMITH SHOP.

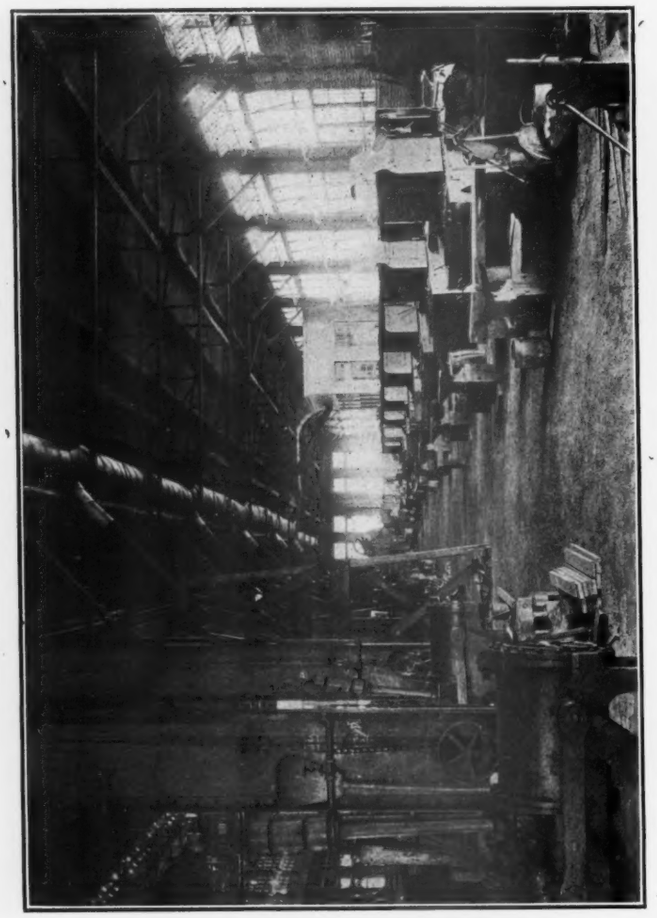


PART LONGITUDINAL SECTION OF SMITH SHOP.

room and the ventilation afforded by the ventilators and such of the windows as are usually open in the monitor and the sides of the center bay keep the shop clear from smoke and gas.

Equipment and Operation.—The two large furnaces and the two steam hammers at the northwest corner of the shop are used for locomotive frame work and heavy forging. The portion of the shop lying between these two hammers and the material track is devoted to the heavier classes of work and includes in its equipment three steam hammers. The arrangement of the jib cranes used in connection with these hammers is especially good, as may be noted by reference to the general plan. The forges in this part of the shop are spaced 20 ft. center to center. Racks for the small tools are placed along the side walls for the outside row of forges and alongside the columns for the inner row.

All material brought in from the machine and erecting shop for repairs is placed in what is known as the "bone yard" at the end of this section of the shop alongside of the materal track and the parts are not distributed to the forges until work



VIEW FROM THE SPRING DEPARTMENT.

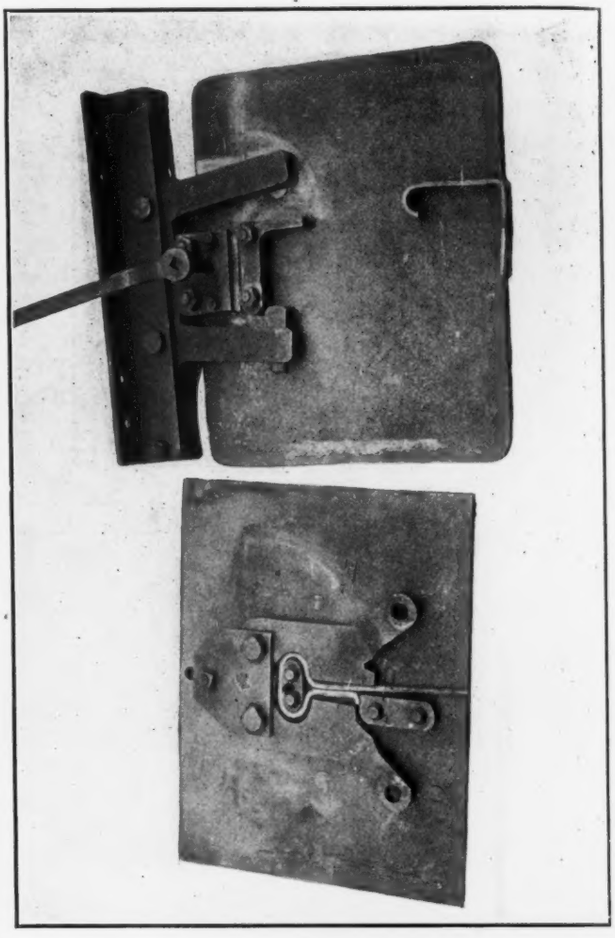
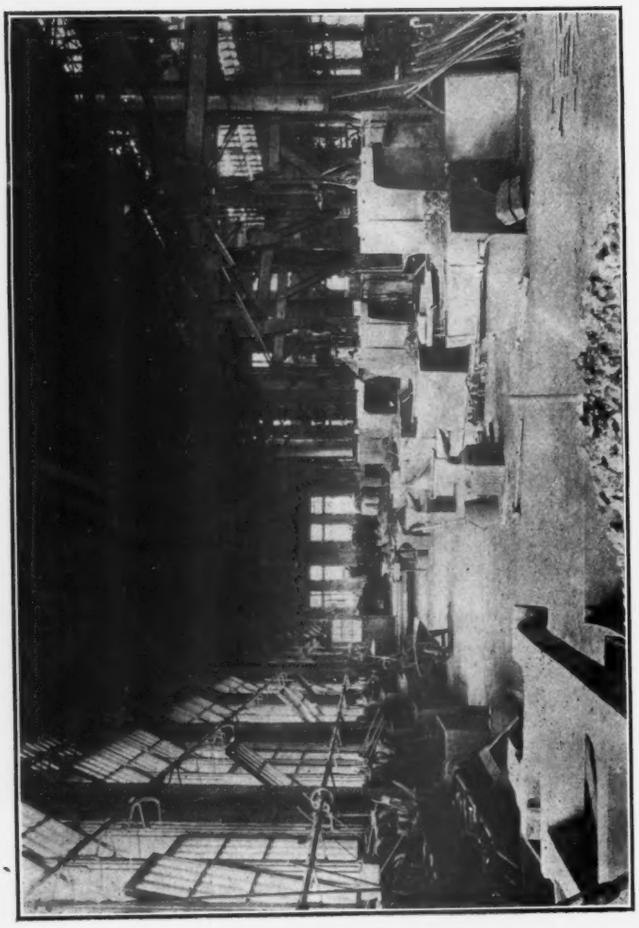
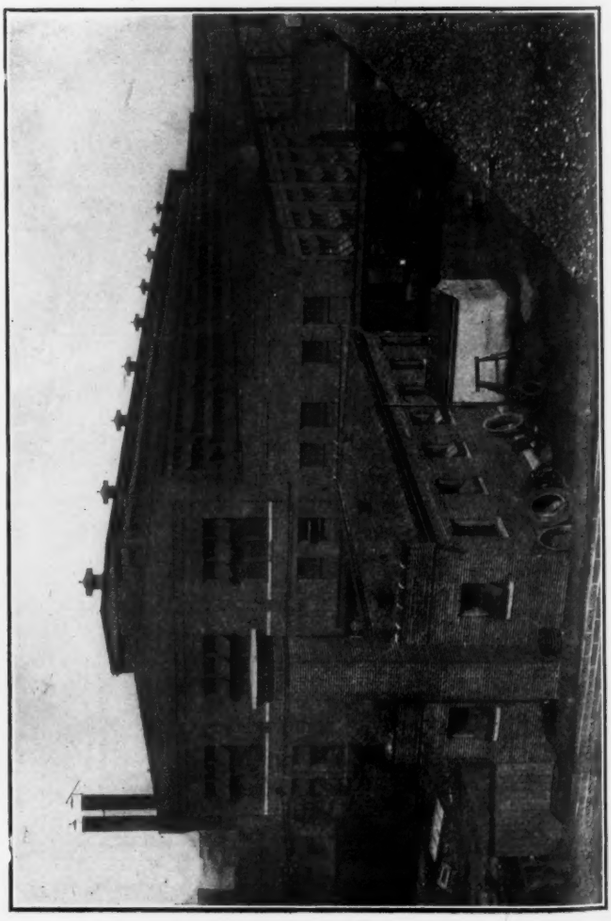


FIG. 2.—DIES USED ON BULLDOZERS.



VIEW FROM THE LARGE STEAM HAMMER.



BLACKSMITH SHOP WITH LAVATORY BUILDING IN THE FOREGROUND.

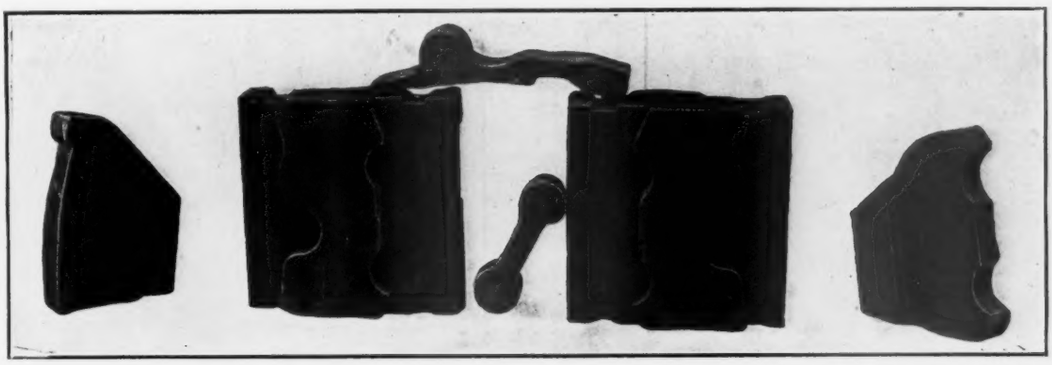


FIG. 3.—DIES AND HEADERS FOR MAKING DRIVER BRAKE AND SWING HANGERS ON THE FORGING MACHINE.

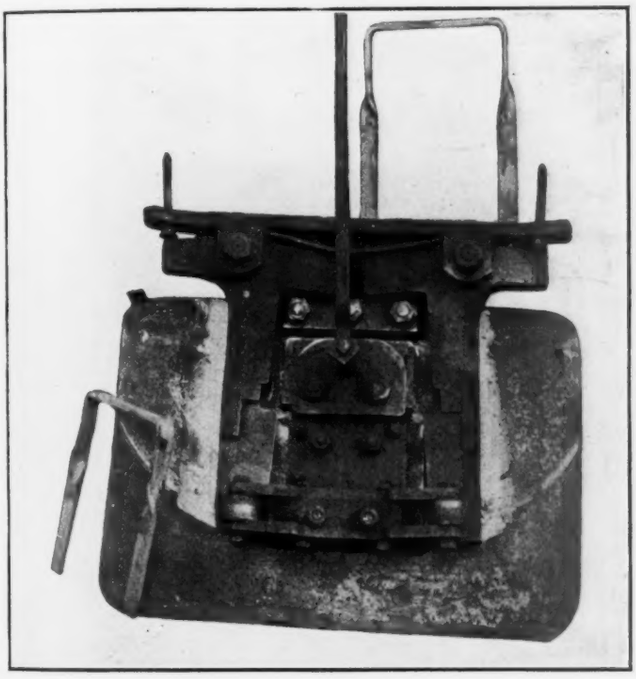


FIG. 1.—DIES FOR MAKING FREIGHT CAR STEPS.

is to be commenced upon them. For this reason there is no tendency for the shop to become littered up and it at all times presents a neat appearance. In addition it enables the foreman to readily check over the repair work on hand and see that work requiring prompt attention is not neglected. The incompleted hammer work is stored in the central aisle at the end of the shop near the large hammers. The large hammer tools and the special dies and formers used in connection with the hammers, of which there are a large number, are stored in a convenient place just outside of the shop.

The spring department occupies the northeast corner of the shop. The equipment for this department has not yet been entirely installed, but it will be carefully arranged so that the various parts will progress from the rough to the finished state with a minimum amount of handling. The forges between this department and the office are used for the lighter classes of work, largely for the car department. They are spaced 16 ft. center to center.

One of the most interesting parts of the shop is that lying between this row of forges and the center of the shop. The large amount and the great variety of work which is turned out by the bulldozers, operated by compressed air, and the Bradley hammers is surprising. Since Mr. Curtis has been in charge of the motive power department he has made it a matter of policy to standardize, as far as possible, all of the cast and wrought iron parts used on the freight cars. This has not only made it possible to reduce the amount of stock carried at repair points, but also to manufacture these parts, and especially those of wrought iron, in large quantities at a correspondingly low cost. The wrought iron parts have been carefully designed with the view of manufacturing them on machines of this kind and with the least possible number of operations. A large number of dies and formers have been made for use with these machines, which when not in use are stored outside of the shop at the end.

Two or three typical devices which are used on the bulldozers are illustrated in connection with the pieces of work which are made by them. Each of these pieces is made in one operation and they can therefore be turned out practically as fast as it is possible to heat the material in the oil furnaces. The device for manufacturing the ladder steps, as shown in Fig. 1, is specially interesting. The hot iron, of the proper length, is placed in the slot between the two pieces bolted to the large plate, which when in use is bolted to the bed of the bulldozer. As the two arms which are attached to the plunger of the bulldozer move forward and come to the position shown in the photograph the iron is bent into approximately a U-shaped form. It will be noted that the two arms are in the form of bell cranks and when the block on the large plate comes in contact with the shorter arms the two long arms are forced toward each other and twist the iron into the shape shown. The two rollers guide these side arms and hold them in place.

The method of making the two pieces shown in Fig. 2 is more simple. In the first one, the two pieces which shape the iron are connected to the plunger by two arms; as the plunger moves forward the two pieces are swung around their fulcrums until they reach the position shown on the photograph. The method of making the second piece is quite similar to that of making the step, shown in Fig. 1.

This section of the shop is provided with two drill presses, placed at convenient points, and with punches and shears.

Of that part of the shop lying on the other side of the material track one portion is devoted to the manufacture of bolts and nuts, another to arch bar and heavy forging and the eight forges in the corner are used for miscellaneous work and such work as may be required by the freight car repair department, the freight car repair shop being directly opposite this end of the shop. The case hardening furnace is between these forges and the office.

The material for the bolt shop is loaded directly from the cars into the large stock rack. Two shears are placed near this rack for cutting the stock to the proper lengths. The machines for use in tapping the nuts are arranged along the side wall. The thread cutters and the Ajax forging machines for manufacturing the bolts are arranged along the line of columns, as shown on the plan.

While the equipment of bulldozers and Bradley hammers, and the devices used in connection with them, are especially complete and the work done on them is noteworthy because of the fact that the number of operations required for a particular piece of work have been reduced to a minimum, the work done on the heavy Ajax forging machines is of still greater importance. The progress which has been made in heavy forging in this shop would seem to indicate that machine forging is still in its infancy.

Generally speaking, the practice of upsetting material is avoided and the desired purpose is accomplished by reducing

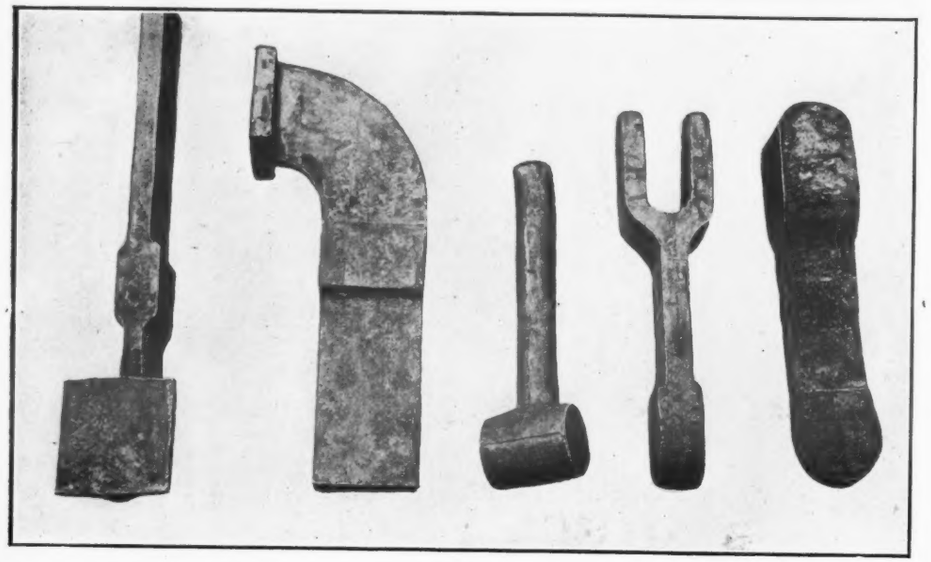


FIG. 4.

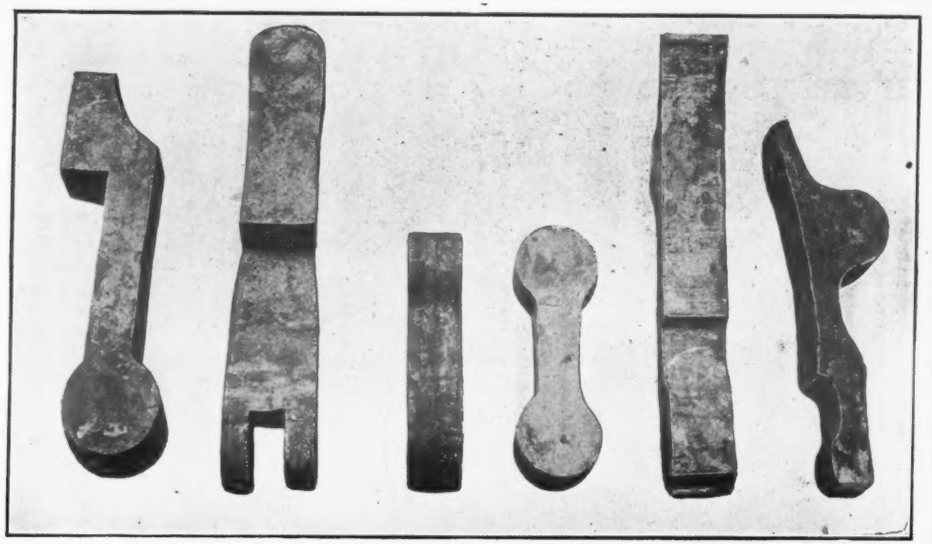


FIG. 5.

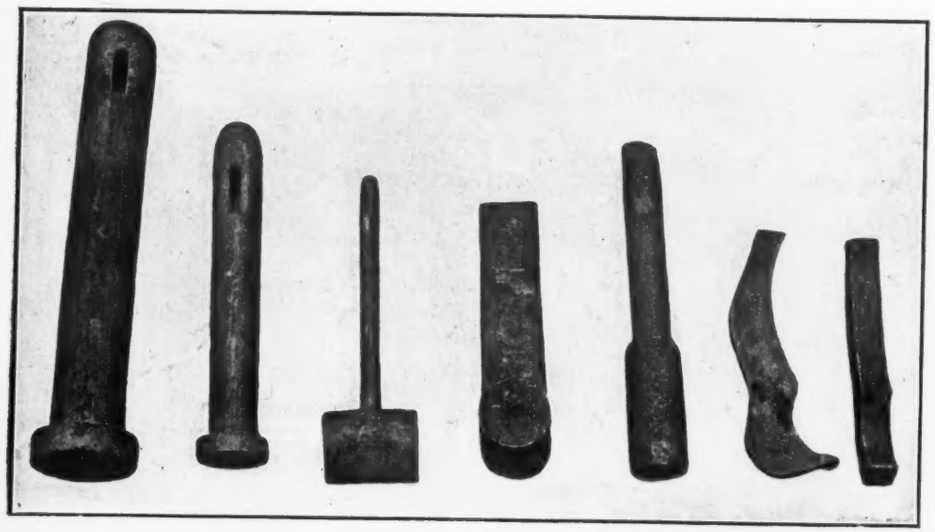


FIG. 6.

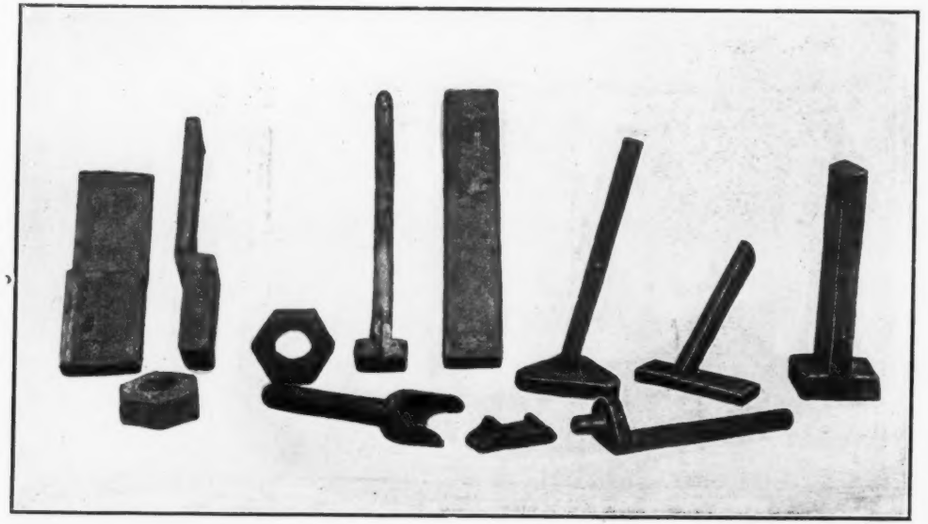


FIG. 7.

FORGINGS MADE WITH JEFFREY COMBINATION DIES ON AJAX FORGING MACHINES.

the stock or welding. Upsetting the material has a tendency to injure it while reducing it tends to refine it. All of the forgings made on these machines, shown in the accompanying illustrations, are made from bar iron which has not had any preparatory work done upon it. This result is accomplished by what is known as the Jeffrey combination dies. As an illustration, the set of dies and plungers used on an Ajax 4-in. machine for making the bottom end of a driver brake hanger and for manufacturing the swing motion hangers for engine trucks is shown in Fig. 3. The exact shape of these two parts is more clearly shown in Fig. 5. The brake hanger is shown resting on top of the dies and is made from bar iron at one stroke of the machine. The swing motion hanger, shown between the two dies, is also made from bar iron at one stroke of the machine. With the dies shown in the illustration these two pieces can be made either by reducing from bar iron or by welding, according to the choice of the operator.

With the Jeffrey combination dies it is not only possible to make the various articles with practically no preparatory work and with a minimum number of operations, but it is also possible to manufacture articles which could not otherwise be made

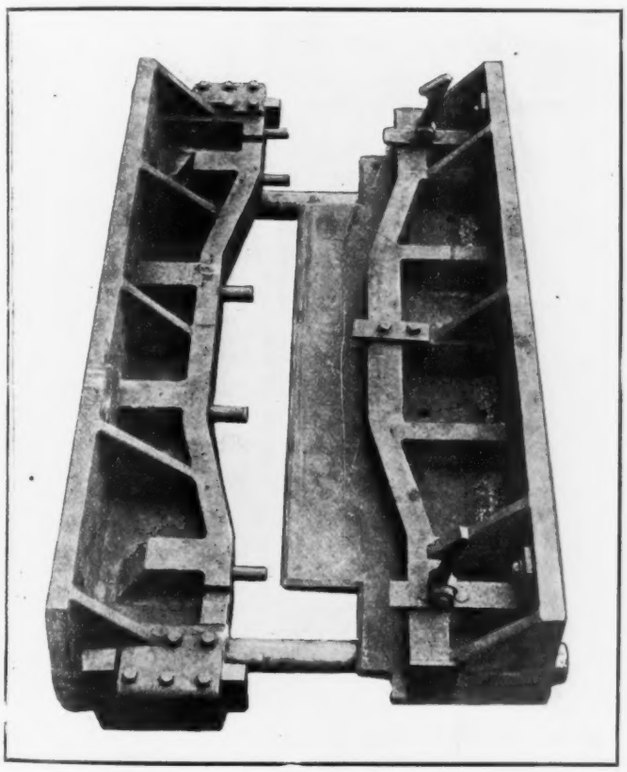


FIG. 8.—DIES FOR BENDING AND PUNCHING ARCH BARS.

on the machine. On the left of Fig. 4 is shown a cross brace which is made with three strokes of the machine. The figure in the center represents the end of a valve rod made with one stroke of the machine and the figure at the right is a swing motion hanger made with two strokes. On the left of Fig. 5 is shown an anchor which is made with two strokes of the machine. Other examples of work are shown in Figs. 6 and 7.

Fig. 8 shows the dies for bending and punching arch bars on a No. 9 Ajax forging machine. Bars of the proper length are placed in the dies and at one stroke of the machine they are finished and ready to be forwarded to the truck shop and placed on the trucks. The dies or formers are guided by the two heavy rods, one at each end. It will be noted that provision is made for bending a lug at each end of the arch bar.

Another feature that is quite noticeable in this shop is that practically all punching is done by means of templets and no time is lost in laying out. The two large drill presses at the end of the shop are used for the heavier classes of work. All the heating furnaces use fuel oil and were furnished by the Railway Materials Company.

Following is a list of the equipment in this shop:

1 6,000 lb. Steam Hammer, Chambersburg.
1 4,500 lb. Steam Hammer, Bement, Miles & Co.
1 3,500 lb. Steam Hammer, Chambersburg.
1 2,500 lb. Steam Hammer, Bement, Miles & Co.
1 1,500 lb. Steam Hammer, Bement Industrial Wks.
1 1,500 lb. Steam Hammer, Bement, Miles & Co.
1 1,000 lb. Steam Hammer, Sellers.
4 200 lb. Bradley Hammers.
1 No. 9 Ajax Forging Machine.
1 4 in. Ajax Forging Machine.
1 2 in. Ajax Forging Machine.
1 1½ in. Ajax Forging Machine
2 1 in. Ajax Forging Machines.
2 1 in. Oliver Forging Machines.
3 18 in. Compressed Air Bulldozers, L. & N. R. R.
1 10 in. Compressed Air Bulldozer, L. & N. R. R.
1 Eye Bolt Header, Williams, White & Co.
1 Combination Punch and Shear (D H.). Punch reach, 27 in.; Shear, 28 in. Bement, Miles & Son Industrial Wks.
1 No. 5 Punch, 15 in. reach, Hilles & Jones.
1 Shear and Trimmer, 24 in. reach, Sellers.
2 Round Iron Shears, Bement, Miles & Co.
3 34 in. Drill Presses, Harrington & Son.
1 36 in. Drill Press, Niles.
1 30 in. Drill Press, Putnam Machine Co.
1 30 in. Drill Press, David W. Pond Co.
1 36 in. Drill Press, Aurora Tool Wks.
1 4 Spindle Drill, W. F. & J. Barnes Co.
3 1½ in. Threading Machines, 2 Spindles, Acme.
1 2 in. Threading Machine, 2 Spindles, Acme.
1 1½ in. Threading Machine, 4 Spindles, Acme.
1 2 in. Threading Machine, 3 Spindles, Acme.
1 2 in. Nut Tapper, 6 Spindles, Acme.
1 1½ in. Nut Tapper, 6 Spindles, Acme.
1 ¾ in. Nut Tapper, 2 Spindles.
1 1 in. Nut Tapper, 6 Spindles, Acme.
1 2 in. Nut Tapper, 4 Spindles.
1 ⅞ in. Nut Tapper, 6 Spindles, Bement Industrial Wks.
4 No. 1 Heating Furnaces, Railway Materials Co.
9 No. 2 Heating Furnaces, Railway Materials Co.
5 Box Furnaces, Railway Materials Co.
Case Hardening Furnace, Railway Materials Co.
Axle Furnace, Railway Materials Co.
Emery Grinder, L. & N. R. R.

In one of the additions to the building are two No. 10 and one No. 7 Sturtevant air blast fans. These are driven by two motors, a 60 h.p. and a 100 h.p. The air is conducted to the forges through three systems of underground tile conduits.

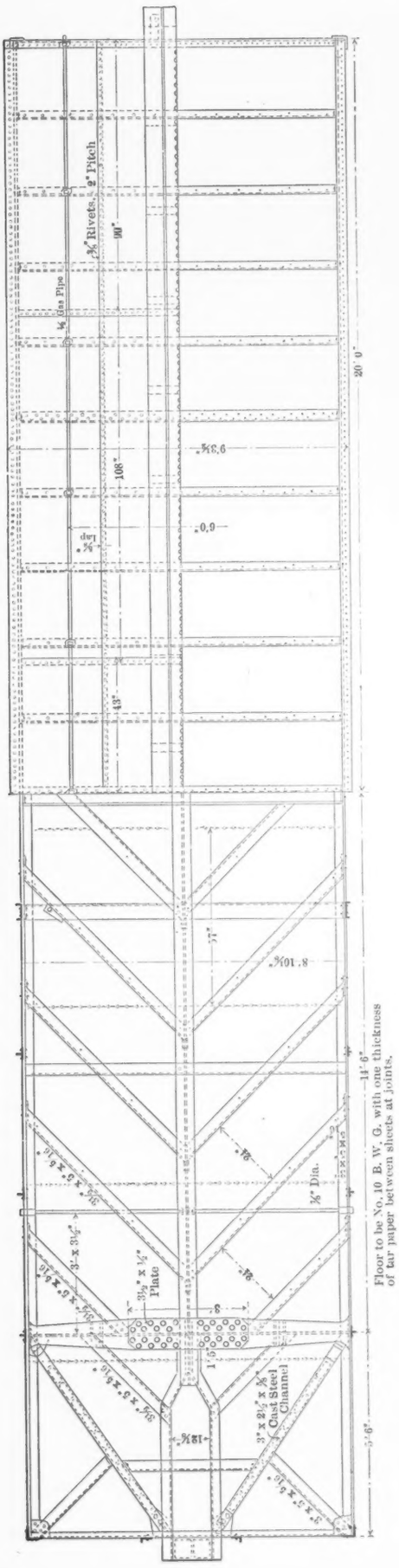
Raw material is stored north of the building and is brought into the shop over a system of larry tracks. The material is neatly arranged and is divided into sections by streets or avenues.

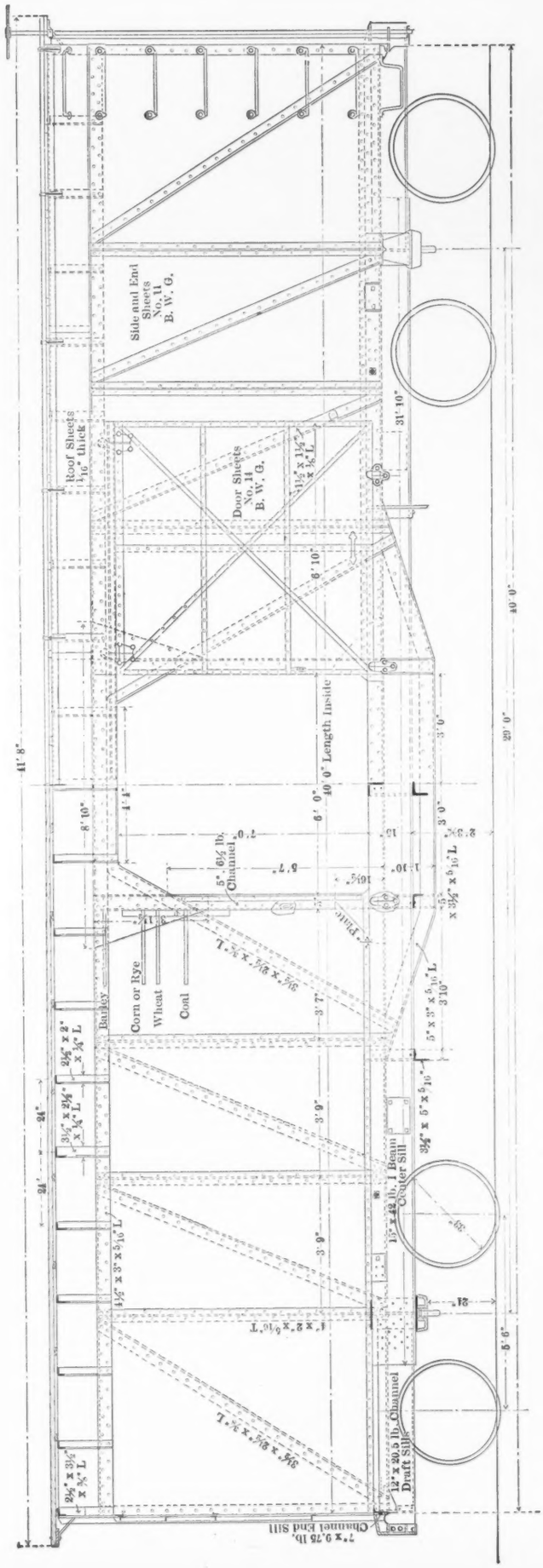
Steel Ties on the Pennsylvania Railroad.—A committee appointed to investigate the wreck of the 18-hour express at Mineral Point, Pa., on February 22, recommended that because of the lack of positive evidence as to the cause of the derailment and as the damages subsequent to the derailment were more serious than would have been the case with wooden ties, that the remaining steel ties be removed. The following extracts from a communication by Mr. A. C. Shand, chief engineer of the Pennsylvania Railroad, to the *Railroad Gazette*, are of interest in this connection:

"I would be greatly obliged if you would call the attention of your readers to the fact that, after most careful observation and study of the subject, I am more than ever impressed with the necessity in the near future of a substitute for wooden cross ties, and so far no material has been offered as a substitute that will meet the requirements except metal. I think, however, that all ties tested are a little lighter than they should be, and am firmly of the opinion that none of the fastenings for holding the rail in position on the tie are adequate to the requirements. When any suitable fastening shall have been designed, and there is no doubt in my mind that it will be in the near future, either by the Carnegie Steel Company or by someone else, I have not the slightest doubt that the experiments in connection with the steel ties will go forward, not only on this system, but on other leading railroads."

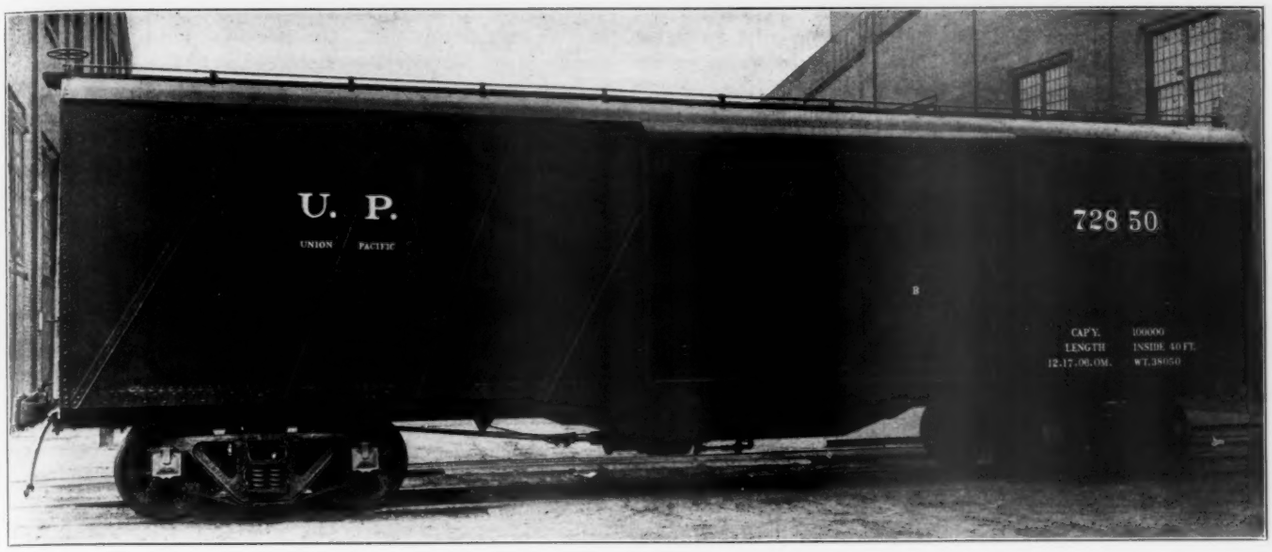
"What I am afraid of is that the general public, and the engineering profession in particular, will dismiss the subject of steel ties as a failure, when in reality they must come sooner or later, and the more intelligent thought given to this matter the sooner a suitable tie will be furnished which will be satisfactory in every particular."

Hard vs. Soft Boiler Scale.—It seems probable that soft, porous scale would more effectively retain against the tube surface a layer of water or vapor of low conducting power. Such facts seem to indicate that we should accept with caution the assumption that hard scale will cause a greater loss than soft scale.—*Edward C. Schmidt before the Western Railway Club.*





PLAN AND SIDE ELEVATIONS OF ALL-STEEL FORTY-FOOT BOX CAR—UNION PACIFIC RAILROAD.



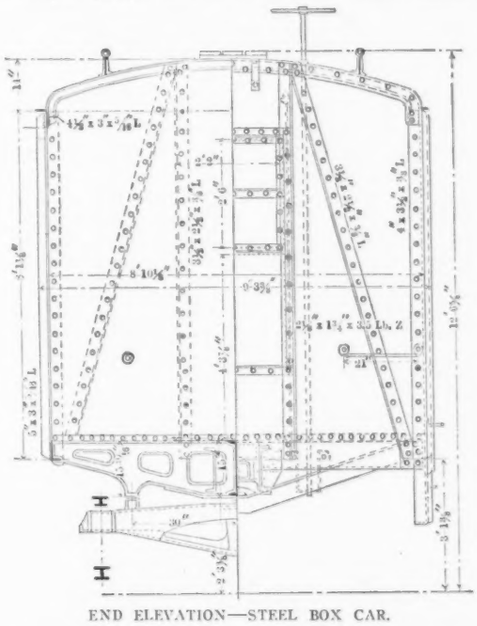
ALL-STEEL BOX CAR—UNION PACIFIC RAILROAD.

ALL STEEL BOX CAR.

Union Pacific Railroad.

There has recently been finished at the Omaha shops of the Union Pacific Railroad two all-steel box cars which, as far as we know, are the first all-steel cars of this type ever built. These two cars are of slightly different design and have been constructed as sample cars, the service of which will be closely watched. The results obtained on the road will determine the value of the type and the features of design for future cars.

The car illustrated weighs 38,050 lbs. total. The other all-steel car weighs 38,450, and the Harriman Line standard 40-ft.



END ELEVATION—STEEL BOX CAR.

wooden box car weighs 42,200 lbs. and is somewhat smaller in cubic capacity. The two steel cars have the same inside dimensions, being 40 ft. long, 8 ft. 10⅛ in. wide and 7 ft. 11 in. high, making them 4 in. wider than the standard wooden car and 1 in. less in height. The cubic capacity is 2,800 cu. ft. and the weight capacity is 100,000 lbs.

The difference in design between the two steel cars is confined to the side framing and will be pointed out in detail in a following paragraph.

The illustrations show the construction quite clearly, and from an inspection of them it will be seen that the designer in taking up a car of all steel has departed from the usual arrangement of wooden cars and has made such a distribution of metal as to obtain the proper strength and resisting qualities without excess weight, the result being that a car has been designed which, while of the same capacity, weighs 4,150 lbs. less in the car illustrated, and 3,750 less in the other all-steel design, a saving of nearly 10 per cent. of the weight of the wooden car or a saving of about 3 per cent. in the weight of the wooden car loaded to its full capacity. This means that in a 70 car train of fully loaded cars two extra cars of this design could be hauled on the same rating.

The center sill has been made of a single 15-in. 42-lb. I beam, which extends continuously between and through the bolsters, being terminated 17 in. beyond them. To the web of the projecting section are riveted two 12-in. 20½-lb. channels, which are bent outward from the connection, forming two draft sills 12⅞ in. apart, extending through and beyond the end sill. The end sill consists of a 7-in. 9¾-lb. channel cut away on its lower side for the coupler shank, and at this point is located a steel casting joining the draft sills and end sill and forming a support for the coupler. The side sill consists of a 3 x 5 x 5/16 in. angle continuous from end sill to end sill, which is reinforced below the door opening by a short girder having the side sill as its upper member and a lower member of the same sized angle bent to the proper contour to form a girder 22 in. deep in its center and between door posts, and terminating at the foot of the adjoining side posts. The web of this girder is formed by continuing the side plating below the side sill and under the door opening.

The cross bracing between the center and side sills is made up of 3½ x 4 x 5/16 in. angles set at an angle of about 45 degrees with the center line and spaced 24 in. apart. These are properly trimmed and flanged for connection to the web of the center and side sills. There are also 5 angles of the same size extending continuously below the center sills and connecting to the side sills. One of these is located below each door post, one in the center of the door opening and one connecting at the end of the side sill girder. The end frame bracing between the bolster and end sill is formed of two cast steel channels between the junctions of the draft sill and end sill and the bolster with the side sills, as well as two angles between the corners and these diagonal steel channels. There are also diagonal braces between the bolsters and the back end of the draft sills.

The superstructure or body framing consists of a 4½ x 3 x 5/16 in. angle plate, 4 x 2 x 5/16 in. tee iron posts and angle diagonal braces. In this design there is one post over the bolster and two posts between that and the door posts with diagonals between each. The corner posts are of 4 x 3½ x ⅜ in. L's and the end posts of lighter angles, there being two diagonals in the end structure, as shown in the illustration. The door posts are made up of 5-in. channels extending from the bottom member of the girder below the door opening to the side plate. The diagonal brace at this

point extends from the bottom of the adjacent post, which is the end of the side sill girder, to the side plate at a point inside the connection to the door post, and thence continuously above the door opening and down on the other side in the same manner, thus forming a truss around the door opening, with the door posts as the vertical members and the side girder as the tension member. The construction is further reinforced by ¼ in. gusset plates between the plates and the diagonals and between the door posts and side sills.

The other design of all steel car differs from the one shown by having this truss extending all the way between the bolsters. The diagonals between the vertical posts inside the bolsters are eliminated and the angle forming the upper member of the truss extends from the junction at the bolster continuously over the door opening, the part from the bolster to door posts being reinforced by a second angle of the same size. The side sill girder is also lengthened to extend between bolsters, having its deepest part between the door post in the same manner as the car shown. That arrangement makes it necessary to use one additional post between the bolster and the door and to cut the vertical posts at the junction with the diagonal, which point is then reinforced by a gusset plate. For this reason, as well as the reduction in total weight, the design shown herewith is considered to be preferable.

The carlins are formed of 3½ x 2½ x ¼ in. L's formed to the proper contour for an elliptical shaped roof and spaced 24 in. apart. They are connected to the side plates only and have no longitudinal bracing, since the roof sheets of 1/16 in. steel give all the stiffness necessary in this direction. The roof is surmounted by a wooden running board and two safety rails. The side sheathing, which is No. 11 B. W. G. steel, or practically ⅛-in. material, is inside the side framing, giving a smooth interior. The floor is of No. 10 B. W. G. steel with flanged connections, giving a perfectly smooth floor. Tar paper is placed between the sheets at the joints.

The doors are formed of steel plates and braces, as is clearly shown in the illustration. The bolsters are of cast steel in two pieces, 15 in. deep at the center and secured to the center sill by top and bottom cover plates. They were supplied by the Buckeye Steel Castings Co., Columbus, Ohio.

The trucks have the Andrews cast steel side frames, 600-lb. wheels and M. C. B. standard axles, with 5½ x 10-in. journals. Sessions Type C draft gear has been applied to both steel cars.

STEEL PULLMAN SLEEPING CAR.

The Pullman Company has recently completed an all steel sleeping car, which, in arrangement and size, conforms to the present standard twelve section car. It is being placed on private exhibition at a number of the larger terminals throughout the country and is run on short trips out of these terminals with parties of guests aboard. The car is named Jamestown, and it is expected that it will be placed on exhibition at the Jamestown Exposition during the coming summer.

The framing of the car throughout is of steel and practically all of the finishing is steel, aluminum, brass or fire proofed composite board. The underframe consists of two 15 in. I-beams with a ½ in. cover plate on top only, which extend continuous through the body end sills. Each center sill is trussed with a 2 in. truss rod, with the saddle on the bolster and posts on the two center cross bearers, the ends being anchored to the body end sills. The bolsters are of the double type and are in a steel casting integral with the body end sill and the platform beams, draft sills, centre plate and bridge and side bearings. This is a very large casting and combines within itself practically all of the end of the underframe. It was furnished by the Commonwealth Steel Co. The platform end sills are also steel castings and are riveted to the platform casting. The cross bearers are 4 in number equally spaced between the body bolsters and are of cast steel in one piece. They extend under the centre sills and are of the open or truss type. Floor beams are located between each cross bearer and also between the cross bearer and the bolster, and are 4 in. channels laid with the web horizontal. They are fastened between the centre and side sills. The side sills, which form the lower members of the side girders, are 6 x 6 x ½ in. angles continuous between end sills. The web of the side girder is a ¼ in. plate about 30 in. deep and forms the side sheathing of the car below the windows. The upper member of the girder is a 3 in. steel bar on the outside of the side posts, which are offset around it. All the rivets in the side sheathing are counter sunk and filed to a smooth finish, giving the car an exceedingly good appearance.

The side posts consist of 4 in. I-beams, two in number for each wide pier and single beams for narrow piers. These posts are continuous from the side sill to the deck sills, the upper part forming the carline for the side deck. They are offset at the bottom, belt rail, plate and other points where necessary to clear continuous members. Wherever possible the webs of these posts are punched full of holes for reducing weight and giving a passage for electric wires, etc. The pier covers are 1/16 in. steel plate and are put on with counter sunk rivets. The deck sill consists of a T-iron extending continuous between the body end plates and is secured to the ends of the side posts, which form the carlins of the side roof. The carlins in the upper deck are 1/16 in. pressed steel of channel section and formed to the proper contour. These carlins also form the deck posts at the double piers but at the narrow piers the deck posts are flat bars. The purlins are of 1/16 in. steel pressed in channel shape. The roof is of galvanized iron with copper flashing.

The end frame construction consists of 2 posts of 4 in. I-beam section located under the deck sills and secured to them and to the body corner post at this point. At the bottom they are secured to a 4 x 4 in. angle, which is riveted to the body end sill casting.

The floor construction is double, the deadening floor being placed on top of the cross bearers and floor beams and above this is supported the floor of the car formed of Monolith cement laid on corrugated iron of Keystone section. Between these two floors is placed the deadening material. Two thicknesses of asbestos board are placed in the sides and ends of the car between the sheathings and extending from the side sill to the side plate for reducing noise and as insulation.

The interior finish consists of pressed steel seat frames with the usual plush seats; pressed steel upper berths and attachments as far as possible. The interior is finished in a light gray shade with suitable decorations and striping and gives a very light, clean appearing interior. The fittings are of the usual Pullman standard. The trucks are of the six wheel type having cast steel frames and bolsters. This car throughout has a most satisfactory appearance and is claimed to be a very quiet, easy riding sleeping car.

Courses in Railway Engineering.—The University of Illinois is issuing a small leaflet giving general information about the courses offered in the School of Railway Engineering Administration, which has recently been established. These courses are exceedingly practical and furnish facilities for the proper equipment of high class men for any department of railroads The University is possessed of an excellent dynamometer car for steam railroad usage; a high class electrical railway test car; as well as very complete laboratories and shops. The instructing staff has been very carefully selected for this special work and promises to make the school one of the best of its kind in the country.

Increase in Rolling Stock in Ten Years.—The following table is given in a report recently made by Mr. Slason Thompson to the General Managers' Association of Chicago:—

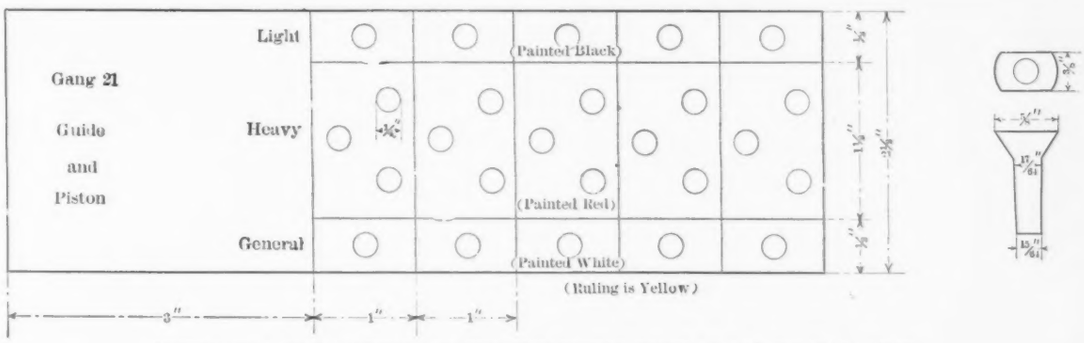
	1906.	1896.	Increase in 10 years, per cent.
Locomotives:			
Number	51,357	35,950	42.8
Weight (tons)	3,286,848	1,797,500	82.8
Average weight (tons)	64	50	28.0
Freight cars:			
Number	1,851,409	1,221,887	51.5
Capacity (tons)	58,455,088	29,936,231	95.3
Average (tons)	32	24.5	30.6

DISPATCHING BOARD FOR ENGINE REPAIRS.

By C. J. Morrison.*

A train dispatcher does not direct the movements of trains, assign meeting points and keep everything moving with nothing but his memory to guide him. He has a board which shows at a glance the position of each train. Reports come in from each station as the trains arrive and depart. In addition he is furnished with information concerning the tonnage of each train and the condition of the engine and is thus able to predict its speed over each portion of the division.

Usually the general foreman is the dispatcher in the locomotive repair shop. In most shops he is expected, without a board and without reports, to dispatch the engines through the shop and keep each up to its schedule. Fortunately mistakes on his part are not as serious as those made by the train dispatcher. Nevertheless, they cost time and money. The average general foreman is asked to carry far more in his head than the train dispatcher would have to carry had he no boards or reports. In a shop which usually holds twenty-five engines and has thirty gangs, the number of possible combinations of the work is so great that it would startle the general foreman to see it printed. Yet, only one combination will produce the best result.



SKETCH OF A SMALL SECTION OF THE DISPATCHING BOARD IN THE ERECTING SHOP.

In the Topeka shops of the Santa Fe, in addition to the schedules and reports described in the December, 1906, issue of the American Engineer, a board has been devised to aid the general foreman, and, as a side issue, the gang foreman. This board shows at a glance the condition of the work on each engine, shows what has been done, what remains to be done, and what is behind schedule. The board is checked up during the day by a time-keeper, so that it is always up to date. It is not necessary for the general foreman to waste his time and energy running up and down the shop to ask first one, then another foreman if his work is done. He can glance at the board and direct his foremen over the telephone.

The board is 5 ft. high and 6 ft. wide, and is ruled in thirty horizontal sections, part of one of which is shown in the sketch. The vertical sections represent the days of the month and are numbered from one to sixty-one, so as to carry two months. A bar of iron ⅛ x 1 in., carried on two horizontal rods of ¼-in. round iron, one at the top and one at the bottom of the board, marks the day. Pegs, as shown in the sketch, with white, green, yellow and pink pasters show the engine numbers. When an engine enters the shop, pegs are made for the work of each gang and placed on the board, on the dates the work is due, in the light, heavy or general repair column according to the class of repairs. Pegs are made for each job, as shown in the general schedule on page 338 of the September, 1906, issue of the American Engineer. As an example, consider the guide and piston gang. The colors signify as follows:

White.....Crossheads Ready
Green.....Guides Up
Yellow.....Pistons Ready
Pink.....Pistons in Engine

When a heavy repair engine enters the shop the white peg will be placed on the date corresponding to the 8th day, the green peg on the 9th, the yellow peg on the 12th, and the pink on the 13th. When the work is completed the pegs are placed in spaces at the right of the board until the engine leaves the shop, when they are removed. As the rod marking the day advances all the pegs back of it represent the work behind schedule, while the pegs in front of it represent work due on that and future dates.

If a gang falls behind in some work that will delay another gang, the peg for the second gang will be advanced to the date when they will be able to proceed. Such a falling behind of one gang may congest the work of another gang at a future date. This is at once shown by the pegs and is provided for in advance. The foremen are furnished every morning with reports which not only show the work that is behind schedule, but the work that is due that day, and, in the cases of some gangs, the work that is due the following day. With such a system as this, there is little excuse for work falling behind schedule, and when work does fall behind, the board shows at a glance which gang is causing the delay.

When a scheme of this kind is advanced the question is always asked—"What addition to the clerical force is necessary?" The reply is—"None." The regular time-keepers move the pegs and the office boy finds time to put the pasters on them. The money saving effected is rather difficult to estimate, as it depends entirely upon the delays eliminated and the value per day of the locomotive.

* General Erecting Foreman, Topeka Shops, Atchison, Topeka & Santa Fe Railway.

Loss of Heat Due to Boiler Scale.—In so far as generalization is warranted we may sum up the results of the tests in the following conclusions:

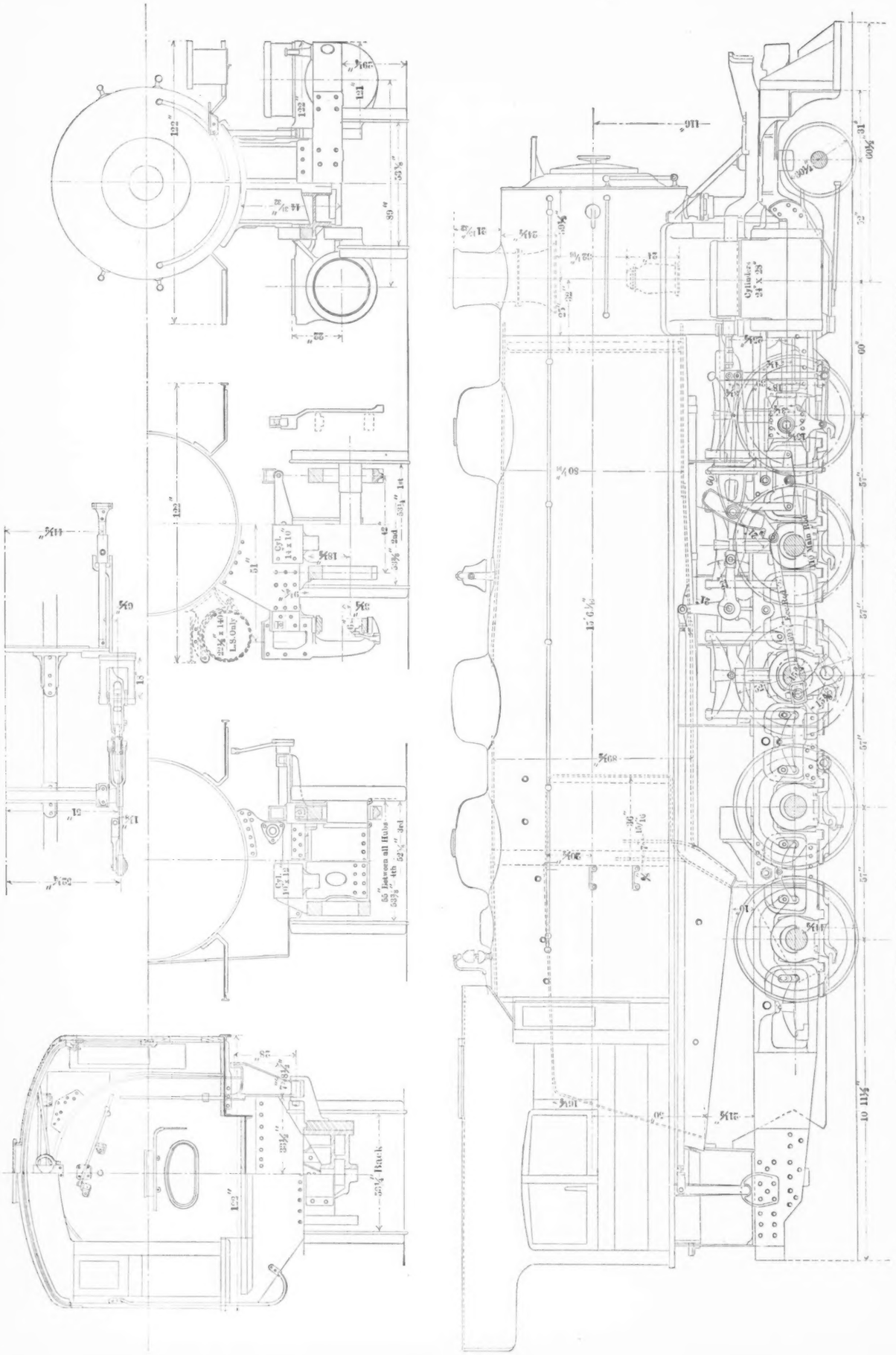
1. Considering scale of ordinary thickness—say of thicknesses varying up to ⅛-inch—the loss in heat transmission due to scale may vary in individual cases from insignificant amounts to as much as 10 or 12 per cent.

2. That the loss increases somewhat with the thickness of the scale.

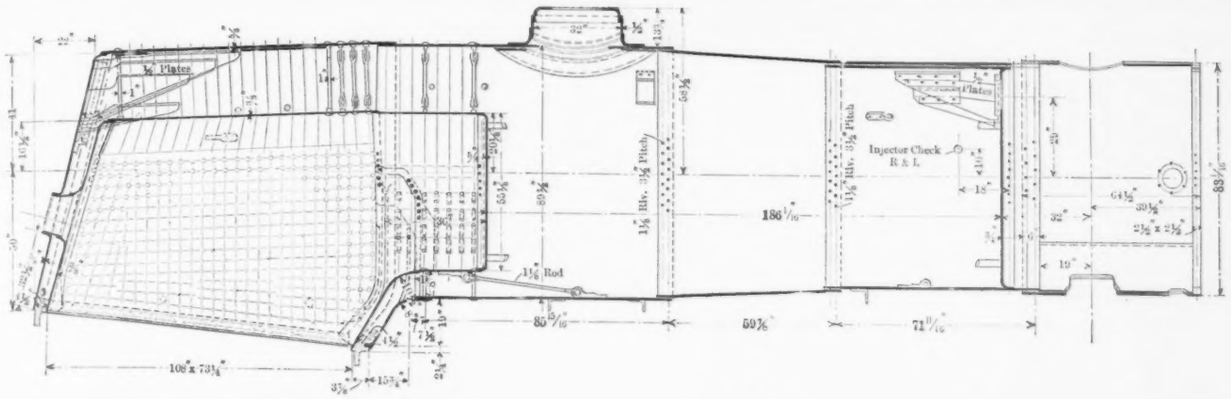
3. That the mechanical structure of the scale is of as much or more importance than the thickness, in producing this loss.

4. That chemical composition, except in so far as it affects the structure of the scale, has no direct influence on its heat transmitting qualities.—*Edward C. Schmidt before the Western Railway Club.*

An Antiquated Argument.—The New York *Sun* publishes this argument which was used in the '30s to prove that canals were superior to railroads for military purposes: "Imagine a regiment of troops with baggage, provisions, ammunition, and camp equipage transported by railroad! By canal this can be done, and the soldiers live, and cook comfortably, on the way." So, too, "canal boats will carry artillery, which cannot be transported by rail unless the guns are dismounted and the caissons taken apart." Finally, "snow will render a three hundred mile railroad impassable for weeks, and rain will wash earth over the rails in quantities which in deep cuts weeks might be needed to remove."—*Railway World.*



GENERAL ELEVATION AND SECTIONS OF SIMPLE DECAPOD LOCOMOTIVE—BUFFALO, ROCHESTER AND PITTSBURG RAILROAD.



SIMPLE DECAPOD LOCOMOTIVE

BUFFALO, ROCHESTER & PITTSBURG R. R.

The American Locomotive Company is building six decapod or 2-10-0 type locomotives at its Brooks Works for the Buffalo, Rochester and Pittsburg Railroad. These engines are intended for pushing service and are the heaviest simple locomotives ever built by that company. As is shown in the table below, they are exceeded in weight and power by but one other simple locomotive on our records.

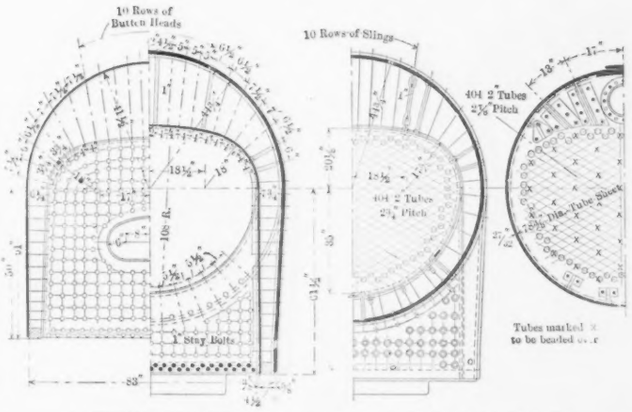
They have 24 x 28-in. cylinders, 52-in. drivers and carry a steam pressure of 210 pounds. This gives a theoretical tractive effort of 55,350 pounds, giving an adhesive ratio of 4.48. The steam is distributed by outside admission slide valves driven by the Walschaert type of valve gear. The valve gear link is supported by a special shaped casting secured to the back of the guide yoke and the reverse shaft is carried in bearings bolted to the top of a cast steel cross tie located between the second and third pair of driving-wheels. This permits of the direct connection of the reverse shaft arm with the radius bar. Reference to the illustration of the side elevation will show the advantage taken of the opportunity afforded by the use of this type of valve gear for the introduction of strong bracing between the frames and the frames and boiler.

One of the interesting features of this design is the use of a combustion chamber in the boiler. The results in the way of a reduction in boiler troubles obtained by the use of the combustion chamber on the Northern Pacific Ry. have been most satis-

Type	2-10-2	2-10-0	2-10-0	2-8-2	2-8-0
Owner	P. S. & N.	B. R. & P.	A.T. & S. F.	N. P.	D. & H.
Builder	Bald	Amer.	Bald	Amer.	Amer.
Total weight	288,000	275,000	266,500	261,000	246,500
Weight on drivers	235,000	248,000	237,000	205,000	217,500
Tractive effort	60,000	55,350	62,500	46,630	49,690
Cylinders	28x32	24x28	19 & 32x32	24x30	23x30
Diameter drivers	57	52	57	63	57
Steam pressure	160	210	210	200	210
Combustion chamber or superheater	Sup'r.	C. C.	No.	C. C.	No.
Total heating surface	4796	3535.5	5390	3437	4045.5
B. D. factor	715	815	660	835	700
Equated heating surface	1235	1085.5	1419.2	1030	1309.5
Driving wheel base	19'-9"	19'	20'-4"	16'-6"	17'
Total engine wheel base	35'-11"	28'-4"	29'-10"	34'-9"	25'-11"

factory, and the introduction of the combustion chamber in these engines shows evidence of an increasing belief in its advantages for wide firebox engines burning soft coal. The advantages claimed are, that it removes the tubes from the hottest part of the fire, thereby decreasing flue leakage; adds to the heating surface of the firebox; and gives a largely increased firebox volume which tends towards better combustion. In these engines the combustion chamber is 3 feet long and is stayed to the shell of the boiler by radial and sling stays on the upper section and by radial stays on the sides and bottom, bracing rods being also attached to the bottom and extending forward to the waist to add stiffness. Ample clearance between the combustion chamber and the shell of the boiler is provided to furnish good water circulation.

The boiler is of the conical wagon top type 80 inches in diameter at the front and has a total heating surface of 3,535.5 square


10 Rows of Button Heads
10 Rows of Slings
404 2 Tubes 2⅛" Pitch
404 2 Tubes 2¼" Pitch
Dia. Tube Block
Stay Bolts
Tubes marked x to be beaded over
83"

SECTIONS OF BOILER—B., R. & P. DECAPOD LOCOMOTIVE.

feet, of which the tubes contribute 3,280 square feet and the firebox the remainder. The tubes are 2 inches in diameter and 15 feet 6 1/16 inches long, there being 404 in the barrel of the boiler. The introduction of the combustion chamber, of course, reduces the amount of tube heating surface; but the experience of the Northern Pacific Railway indicates that the increase in firebox heating surface more than offsets this loss, it being found that engines with combustion chamber and less actual heating surface steam fully as well as those without combustion chamber and more heating surface.

The accompanying table will permit comparison between these and other recent large locomotives of several types. In considering this table it should be noted that the Northern Pacific 2-8-2 type is also fitted with a combustion chamber.

Other interesting details of these locomotives will be considered in our next issue. The general weights, dimensions and ratios are as follows:

GENERAL DATA.

Gauge	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive Effort	55,350 lbs.
Weight in working order	275,000 lbs.
Weight on drivers	248,000 lbs.
Weight of engine and tender in working order	437,000 lbs.
Wheel base, driving	19 ft.
Wheel base, total	28 ft. 4 in.
Wheel base, engine and tender	65 ft. 3½ in.

RATIOS.

Weight on drivers ÷ tractive effort	4.48
Total weight ÷ tractive effort	4.96
Tractive effort × diam. drivers ÷ heating surface	815
Total heating surface ÷ grate area	63.6
Firebox heating surface ÷ total heating surface, per cent	7.25
Weight on drivers ÷ total heating surface	70.3
Total weight ÷ total heating surface	77.5
Volume both cylinders	14.7 cu. ft.
Total heating surface ÷ vol. cylinders	241.5
Grate area ÷ vol. cylinders	3.8

CYLINDERS.

Kind	Simple
Diameter and stroke	24 x 28 in.

VALVES.

Kind	Slide
Greatest travel	6¼ in.
Outside lap	1 in.
Inside clearance	0 in.
Lead in full gear	3/16 in.

WHEELS.

Driving, diameter over tires	52 in.
Driving, thickness of tires	4 in.
Driving journals, main, diameter and length	10½ x 13 in.

Driving journals, others, diameter and length	10 x 13 in.
Engine truck wheels, diameter	30½ in.
Engine truck, journals	6½ x 12 in.

BOILER.

Style	Conical
Working pressure	210 lbs.
Outside diameter of first ring	80 in.
Firebox, length and width	108 x 73¼ in.
Firebox plates, thickness	⅜ and ⅝ in.
Firebox, water space	4½ in.
Tubes, number and outside diameter	404-2 in.
Tubes, length	15 ft. 6 1/16 in.
Heating surface, tubes	3,280 sq. ft.
Heating surface, firebox	255.5 sq. ft.
Heating surface, total	3,535.5 sq. ft.
Grate area	55.5 sq. ft.
Smokestack, diameter	20 in.
Smokestack, height above rail	14 ft. 11 in.
Center of boiler above rail	116 in.

TENDER.

Tank	Waterbottom
Frame	13 in. channels
Wheels, diameter	33 in.
Journals, diameter and length	5½ x 10 in.
Water capacity	9,000 gals.
Coal capacity	14 tons

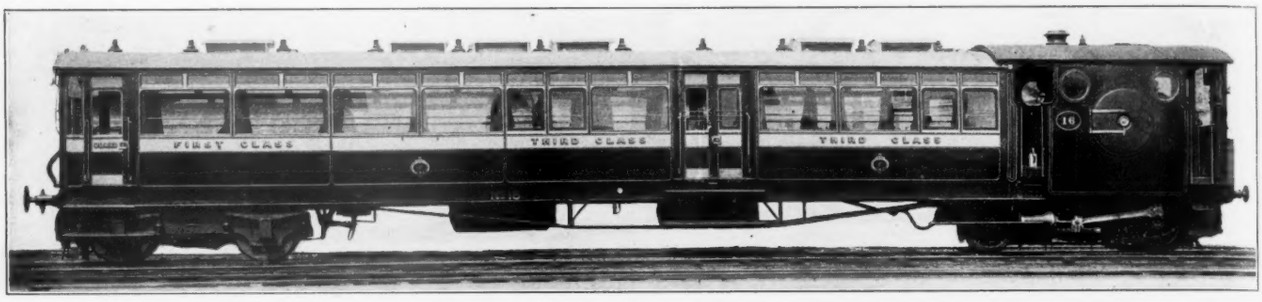


FIG. 1.—STEAM MOTOR CAR, TAFF VALE RAILWAY.

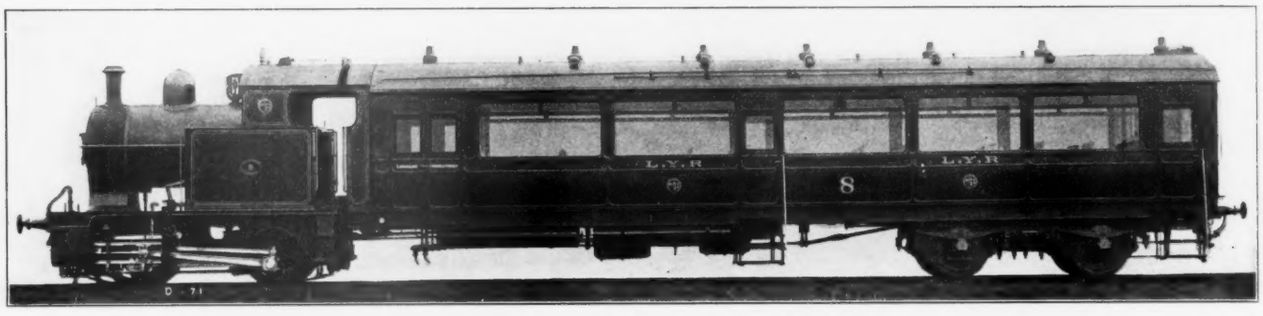


FIG. 3.—STEAM MOTOR CAR, LANCASHIRE AND YORKSHIRE RAILWAY.

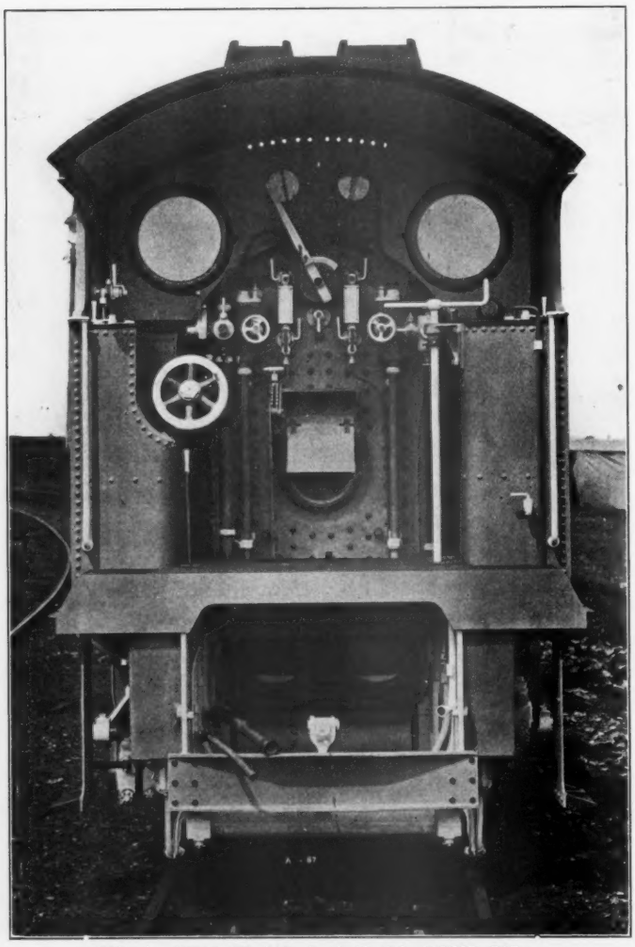


FIG. 4.—VIEW OF CAB, L. & Y. RY. MOTOR CAR.

RECENT STEAM MOTOR CARS IN GREAT BRITAIN

By Charles S. Lake.

The system of working local and branch line traffic by means of self-contained motor cars has been widely developed on British railways during the last few years. The majority of these claim to be operating such cars at a considerable profit in comparison with the previous method of working with a tank locomotive and short train of ordinary cars.

On the Taff Vale Railway, the leading system of its kind in Wales, the motors are in daily use on all parts of the system, and substantial economies have been effected in the working expenses. This line, which is an agglomeration of branches, lends itself particularly well to the profitable employment of motor traction for lighter service. A statement has recently been issued setting forth the details of working costs respectively for the motor cars and a train comprised of a small tank engine hauling a train of four coaches. The net showing in this is that the motor cars can be run for 10.96 cents per train mile, whereas it takes 29.94 cents per train mile to run the engine and four coaches, a saving of 18.98 cents per train mile in favor of the motor. The comparison is based upon the operating charges of the two methods of working, including cost of coal, water, oil and supplies, cleaning, steam raising, etc., for the engines, lighting, cleaning and oil for the cars and repairs, renewals, wages, etc., in respect to both. The initial cost of construction is not considered. The Taff Vale cars number 16, of which 12 are daily in service, while 4 are kept in reserve. They perform 198 separate journeys daily and carry 6,700 passengers on the average during the same period. The cars are of two separate types, and one of the latest built (in 1906) is illustrated herewith.

This car is propelled by steam supplied by a boiler of peculiar construction, which is shown in one of the illustrations (Fig. 2). The fire box is in the center and there are two barrels with separate nests of flues and smoke boxes, one on either side of the fire box. The smoke boxes connect by uptakes to a single stack

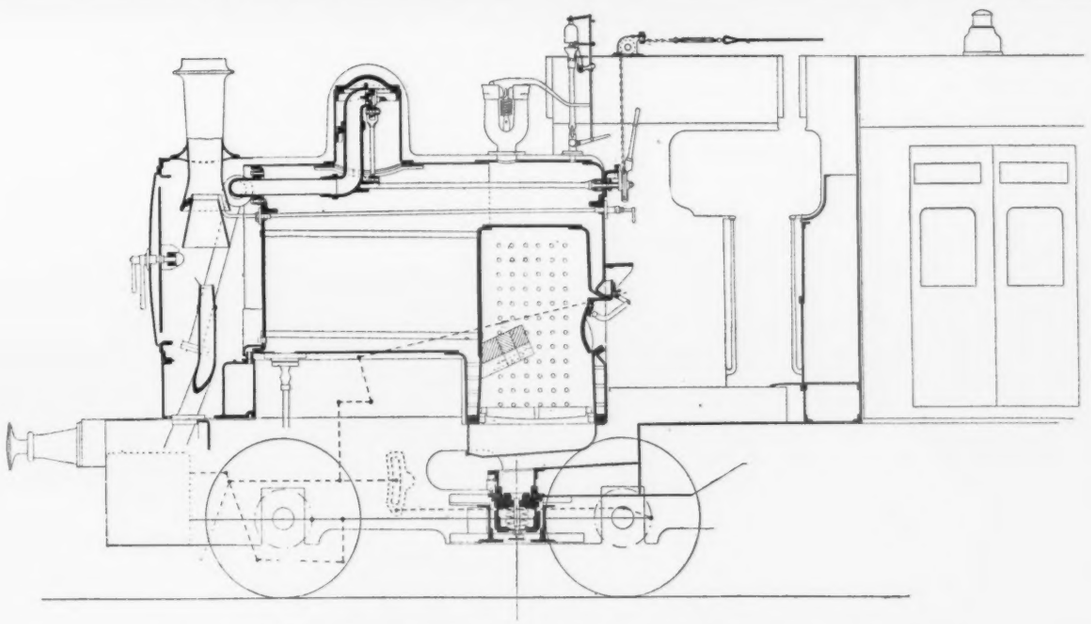


FIG. 5.—SECTION OF MOTOR TRUCK AND BOILER, LANCASHIRE & YORKSHIRE MOTOR CAR.

in the center just back of the dome. This boiler is arranged with the barrels transverse to the center line of the car. The smoke boxes are fitted with hinged doors, one of which can be seen on the outside of the car. Each barrel contains 232-1⅝-in. tubes, 27 in. long, giving a tube heating surface of 414.21 sq. ft., which together with the fire box heating surface of 50.63, gives a total heating surface of 464.84 sq. ft., the grate area being 10 sq. ft.

Steam is supplied at 180 lbs. pressure to a pair of 10½ x 14-in. cylinders. These drive on the forward wheel of the truck, which has a diameter of 42 ins. The slide valves are set vertically on the inside of the cylinders and are operated by a Stephenson link motion. The trailing wheel of this truck is 34 ins. in diameter, and the whole truck with the boiler and including the cab, really forms a small locomotive, and while the end of the motor car is also supported on the center bearing on this truck, the construction is such that the body can be easily detached and a new motor quickly put into place. It is stated that but twenty minutes is required for this change. The firing and operating are done from the forward end of the cab, where large windows give a clear view of the line. A limited supply of coal and water is carried.

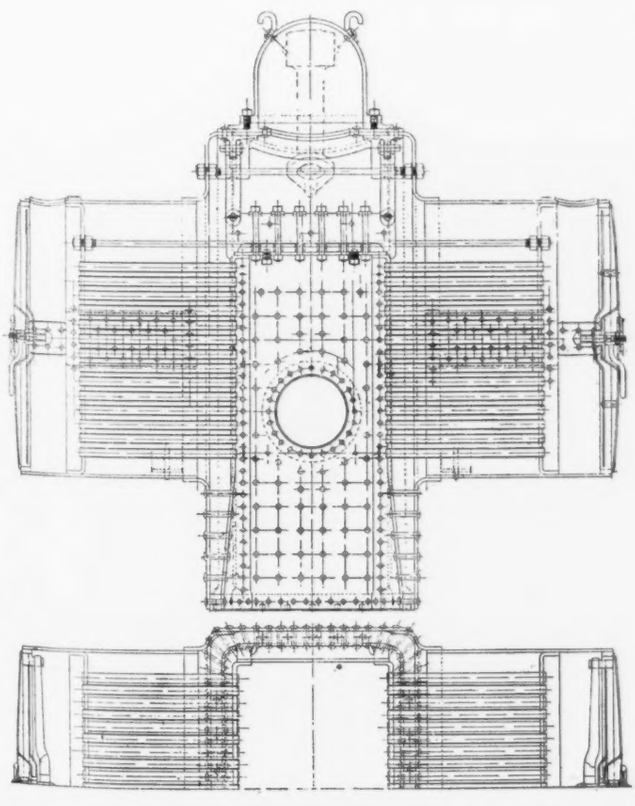


FIG. 2.—BOILER ON TAFF VALE MOTOR CAR.

The body portion of the car has three passenger compartments; first, a smoking compartment for third-class passengers next to the motor room, then a larger third-class compartment, and lastly, a small saloon for first-class passengers. The two third-class portions are divided by a cross gangway with double doors at each end for giving access to and exit from the compartments. At the rear end of the car is a conductor's room, from which the motor can be operated when the car is running with engine behind. The motor truck is fitted with steam and hand brakes, and there is also a hand brake on the car truck. This car is capable of traveling at 35 miles per hour on the level, and at 20 miles per hour on a gradient of 1 in 40. The accommodation is for 56 third-class passengers and for 16 of the first-class. Below are a few leading dimensions:

ENGINE.

Cylinders	10½ x 14 in.
Driving wheels, diameter	42 in.
Trailing wheels, diameter	34 in.
Wheelbase	10 ft.

BOILER.

Total number of tubes	464
Total number of tubes in each barrel	232
Outside diameter of tubes	1⅝ in
Heating surface in tubes	414.21 sq. ft.
Heating surface in firebox	50.63 sq. ft.
Total heating surface	464.84 sq. ft.
Grate area	10 sq. ft.
Working pressure	180 lbs.

WEIGHTS.

Weight (in working order) on drivers	42,000 lbs.
Weight of complete car in working order	100,000 lbs.

CAR.

Total length of body	53 ft. 4½ in.
Wheelbase of truck	8 ft. 0 in.
Total number of passengers	73
Total length over buffers (engine and car)	70 ft. 3⅞ in.
Total wheelbase	59 ft. 8⅞ in.

The other illustrations (Figs. 3-5) show one of the new cars recently put in service on the Lancashire and Yorkshire Railway, an important system operating in one of the most densely populated industrial portions of England. These cars are proving highly efficient and economical in working. They differ somewhat in design from the Taff Vale Ry. car.

The engine is connected to the car in a very similar manner.

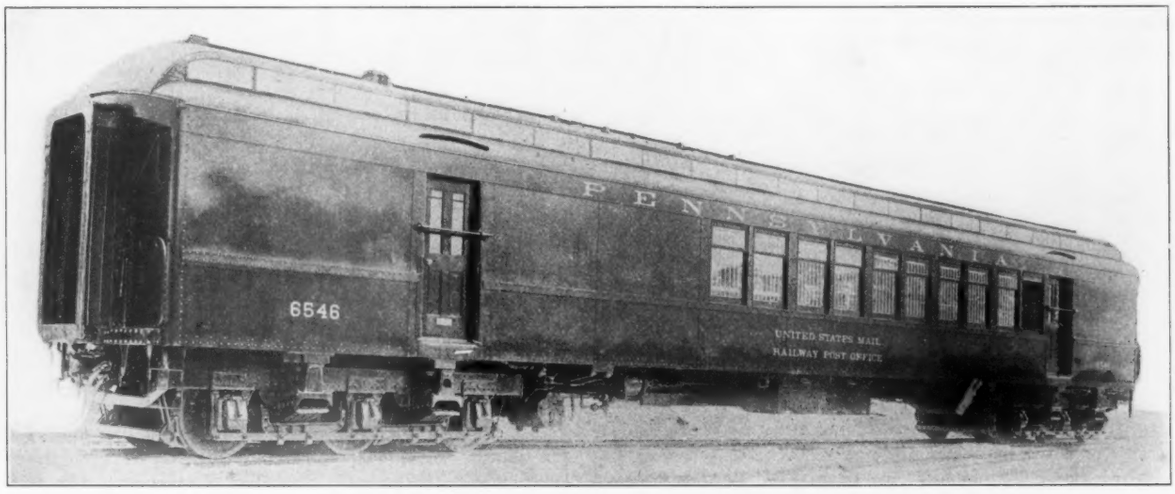
but it has a boiler of the locomotive type with side water tanks. The boiler is similar in design and width to existing Lancashire & Yorkshire Railway locomotive stock, allowing the use of many standard parts and fittings, thus reducing the cost of production. The cylinders are placed outside the frames and steam is distributed to them by superposed flat slide levers worked by Walschaert motion. The four engine wheels are of equal diameter and coupling rods are used. The main rods drive on crank pins in the rear wheels. The throttle valve, whistle, vacuum and hand brakes can be operated by the driver from either end of the car. The car body is divided into three compartments and a baggage compartment; two of these are for passengers and the third is a driver's compartment at the rear end. Only one class of passenger is carried. They are lighted by incandescent gas and warmed by exhaust steam from the engine. Electric bell communication is arranged on the engine and at the trailing end to insure proper control of the car. The motors run on gradients of 1 in 50 and 1 in 40, and have attained speeds of 35 to 40 miles per hour on the level. They have dimensions as follows:

CAR.

Length over buffers	69 ft. 5 in.
Length over car body	47 ft. 6 in.
Width of car body outside	8 ft. 6¾ in.
Width of car body over all	9 ft. 0 in.
Total wheelbase	**54 ft. 8 in.**
Wheelbase of engine truck	8 ft. 0 in.
Wheelbase of car truck	8 ft. 0 in.
Cylinders	12 by 16 in.
Weight in working order	107,280 lbs.
Weight on working wheels	73,080 lbs.

BOILER.

Heating surface, tubes	455 sq. ft.
Heating surface, firebox	54 sq. ft.
Total heating surface	509 sq. ft.
Grate area	9.4 sq. ft.
Steam pressure	180 lbs.



ALL-STEEL 70-FT. POSTAL CAR—PENNSYLVANIA RAILROAD.

ALL STEEL POSTAL CAR.

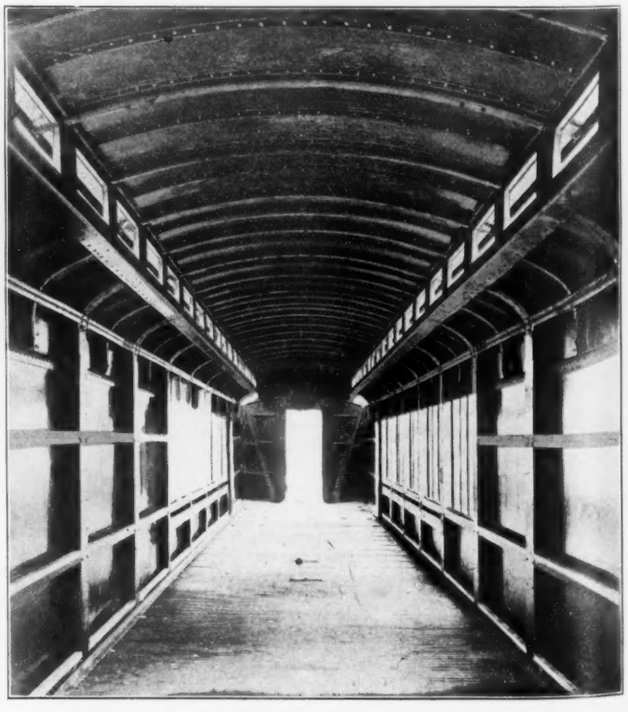
PENNSYLVANIA RAILROAD.

The Pennsylvania Railroad has recently completed what is said to be the first absolutely non-combustible postal car ever built. This car was designed and built at the Altoona shops of the company, and is now in service between New York and Washington, D. C. It is 70 ft. long, or 10 ft. longer than the present standard postal car, and is constructed throughout of steel and fireproof composite and asbestos board. There is altogether 370 lbs. of wood in the car, generally in small pieces, for various purposes for which no other material would be as suitable. By making the car 70 ft. long it has been possible to re-arrange the interior so that the distributing and sorting racks are in the centre of the car and the storage spaces are at either end, thus placing the mail clerks in the easiest riding section of the car, as well as providing much larger storage mail space and making it unnecessary to turn the car at terminals.

The frame work throughout, side sheathing, letter cases, drawers, sorting boards, doors, etc., are of steel. The floor is of cement laid on corrugated steel plates. The interior finish is generally of composite board, and all inside lining and steel plates are covered with asbestos cloth glued to the sheets, which serve as sound and heat non-conductors.

The general scheme of construction follows very closely that used on a steel passenger car recently built at the same shops, which is now in experimental service. This consists of carrying the whole weight of the car and its load on a very heavy box girder type of centre sill, which consists of two 18-in. I beams with two cover plates ½ x 24 in. This girder is set at such a height from the rail as to permit the draft gear to be placed between the centre sills at a point near the centre line, so that all pulling and buffing strains are transmitted in a direct line through these sills.

The body of the car is supported from the centre sills by two cross bearers and the end sills. The cross bearers are located about 19 ft. from the end sills and are about 32 ft. apart. They are constructed of pressed steel shapes and provided with cover plates, so as to make a very strong and rigid support. The end



SIDE AND ROOF FRAMING—PENNSYLVANIA STEEL POSTAL CAR.

INTERIOR OF PENNSYLVANIA STEEL POSTAL CAR.

sills are of similar construction. The car is not provided with body bolsters and the whole weight of the body is conveyed to the cross bearers and end sills by means of the side sills, which really form the bottom members of a plate girder made up of the side sills, the side sheathing below the windows, and the belt rail, the web plate being stiffened and reinforced by the side posts. In the case of the postal car this girder is interrupted at the doors, but since it carries simply the weight of the superstructure of the car and the location of the doors is outside of the point of support on the cross bearers, this does not weaken the construction in any material way.

A very strong body end construction is provided by two 12-in. I-beams located on either side of the end door with the web parallel to the center of the car and securely fastened to the center sills at the bottom and to a cross beam of channel section at the top. The side posts and carlins are of pressed steel shapes of channel section, and the roof and side sheathing above the windows, as above mentioned, is of steel.

The trucks are of the six-wheel type of a special design, which includes no equalizers proper, the wheel pieces of the truck acting in this capacity. The truck bolsters are double and extend out beyond the truck frame for a sufficient distance to allow the side bearings to be located on the side sill. They are provided with spring centering devices. There being no body bolster the center plate is fastened to the center sills.

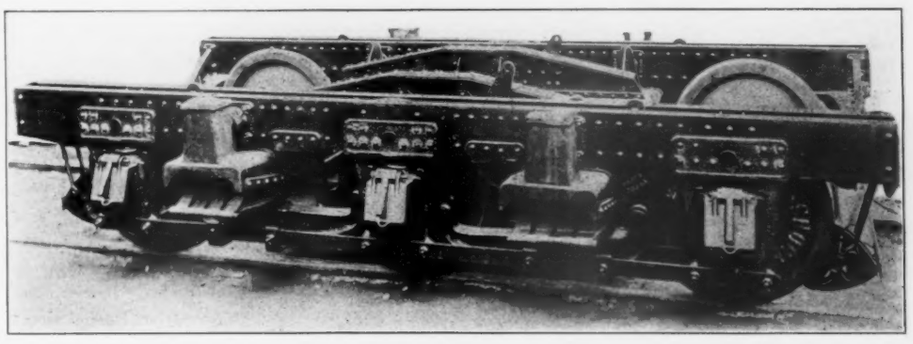
The car is lighted by electricity, using the axle light system, with sufficient storage batteries to furnish 280 ampere hours. Candle lamps are provided for cases of emergency. It is heated by direct steam. A new arrangement is noticed in the windows by the provision of a narrow upper sash which can be lowered, and which is provided with glass in its lower half, and a fine screen in the upper half, so that when lowered it allows ventilation without leaving an opening for cinders to enter or mail matter to be lost, but when raised it presents the usual glass area. Similar provision has been made in connection with the ventilators by the location of permanent screens outside of each sash.

The car is equipped with Westinghouse friction draft gear and rolled steel wheels. It weighs 128,500 lbs. complete and has a length over buffers of 74 ft. 9¾ in. and a width of 9 ft. 11½ in. over eaves. The inside length is 70 ft. 8¾ in., and the inside width 9 ft. ⅝ in.

Motor Cars for the Intercolonial Railway.—The Intercolonial Railway has ordered three motor cars, the motor equipment for which will be built at its own shops at Moncton, N. B. The cars will be 66 ft. in length over end sills and will seat 40 passengers in the passenger compartment and 12 in the smoking room. The framing will be of wood throughout, being sheathed on the outside with cherry. The specifications for the locomotive portion of the car provides that it is to be easily detached from the car body. The engine truck is carried on four wheels coupled, the car body being supported on a cast steel frame attached to the equalizing spring gear of the locomotive. The boiler is to be of the vertical type, so attached to a cast steel saddle that it can be easily removed. It will have 728 sq ft. of heating surface; 11.5 grate area, and a working pressure of 180 lbs. The cylinders will have a diameter of 12 in. and stroke of 16 in. The car is to have a speed of 25 miles per hour on a 1 per cent. grade; the driving wheels being 42 in. in diameter.

Cause of Woodlawn Wreck.—The computations which I have made or examined indicate that the front outer driving wheel of the electric locomotive may have exerted a pressure against the outer rail on the 3-degree 5-minute curve of from 5,000 to 10,000 pounds at a speed of 60 miles per hour. Taking the highest figure, using 17,000 pounds for the ultimate shearing strength of a spike, as determined by Professor Lovell, and considering the pressure as distributed over two spikes, the factor of safety is 3.4, which is satisfactory. These computations hence indicate that the accident must have been due to some other cause than the radial pressure developed under the normal action of the locomotive.—*Prof. Mansfield Merriman.*

Surprise Signal Tests.—During a recent series of surprise tests of signals on the Pennsylvania R. R., 97 per cent. of the enginemen complied with all rules and the other 3 per cent. stopped their trains after passing the signals.



SIX-WHEEL TRUCK, STEEL POSTAL CAR—PENNSYLVANIA R. R.

Never forget that you must begin at the bottom and not at the top if you desire results. Scattering seeds over an unprepared surface is a waste of time! You must plow first! Then the results will be in direct proportion to the persistence with which the work is followed up.—*Mr. Geo. G. Yeomans before the Railway Storekeepers' Association.*

(Established 1832).

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CONTENTS

Blacksmith Shop, South Louisville Shops, L. & N. R. R. 121*
Steel Ties on the Pennsylvania Railroad 127
Hard vs. Soft Boiler Scale 127
All Steel Box Car, Union Pacific Railroad 129*
Steel Pullman Sleeping Car 130
Courses in Railway Engineering, Univ. of Ill. 130
Increase in Rolling Stock in Ten Years 130
Dispatching Board for Engine Repairs, by C. J. Morrison 131*
Loss of Heat Due to Boiler Scale 131
Simple Decapod Locomotive, B. R. & P. R. R. 133*
Recent Steam Motor Cars in Great Britain, Chas. S. Lake 134*
All Steel Postal Car 136*
Motor Cars for the Intercolonial Railway 137
Cause of the Woodlawn Wreck 137
Steam Motor Cars 138
Steel Passenger Cars 138
Steel Box Cars 138
Technical School Training 138
Progress in Transportation, by G. M. Basford 139
Motor Cars in Foreign Countries 140
Automobile Baggage Trucks 140
The Man, Not the System 140
Railroads Which Pay Pensions 140
Aerated Steam 140
Ganz Motor Car, C., R. I. & P. Ry. 141*
Air Brake Instruction Car, C., B. & Q. Ry. 143*
The Tallest Office Building 144
The Recession of Niagara Falls 144
Present Repair Shop Requirements 144
Tonnage Rating, by F. W. Thomas 144*
Higher Cutting Speed With an Intermittent Cut 146
Simple Consolidation Locomotive, C., R. I. & P. 147*
The Card Index—Its Advantages 147
Practical Means for Increasing the Earning Capacity of Freight Cars, by J. E. Muhlfeld 148
Electrical Night at the New York Railroad Club 149
Failure of Lap Joints 150*
Club House for Panama Canal Employees 151
Speed in Miles per Hour 151*
Electric Traction Not Profitable 151
Planer With Pneumatic Clutches 152*
Necessity of Ample Repair Facilities 152
Schmidt Superheaters, Number in Service 152
Dudgeon Universal Hydraulic Jack 153*
New Terminal at Hoboken, D., L. & W. 153
Technical Training in Altoona High School 153
Belt Lacing Machine 154*
Slitter and Disc Grinder 154*
Estimating Locomotive Speed 155
Personals and Books 155
Catalogs and Notes 156

The slight delay in issuing this number is due to the fact that we have made a change in our printing arrangements. This has been done at a considerable expense and we trust that our readers will be pleased with the improved appearance of the paper. In addition to other changes new type has been furnished throughout for both the advertising and editorial sections.

The type of rail motor car which is the most popular in Great Britain, where there are more of these cars in operation than in any other country, is a steam propelled car with the passenger section separate and detachable from the source of power. In some cases the boiler and engines are mounted on a truck which also supports one end of the car, and in others an ordinary light passenger car is coupled to a separate small tank locomotive. The advantage of this is, of course, the ability to remove the machinery section for repairs without laying up the whole car, and is one which would seem to be well worth considering.

There is now either in operation or in course of construction in this country a sample of each different type of passenger service car of the fireproof all-steel design. These include one baggage car, four mail cars, three passenger coaches, one dining car, one sleeping car and a large number of suburban cars. There are also a number of all-steel motor cars of the gasoline, gasoline-electric or straight steam types in operation or under construction. Many well informed men are of the opinion that eventually all passenger service cars in the country will be built of steel, and while the probabilities are that this will be true in cases of special service such as suburban or underground trains, it is still a little early to form any conclusions as to general service. However, it is clearly evident that a fair trial is to be given this new construction, and a few years hence we will probably have some facts on which to base prophecies for the future.

The results of the service given by the two all-steel Union Pacific box cars, which have recently been designed and placed in service, and are described on another page of this issue, will be awaited with great interest by the railroads of this country. While the cars will probably prove to be sufficiently strong, although the side sheets are rather light, it is questionable whether they will prove successful for general merchandise purposes. The service given by two or three hundred iron box cars on the Baltimore & Ohio Railroad, the first ones of which were built and placed in service in 1862, may be of interest in this connection. Previous to that time a number of cars similar to a tank car, but with doors on the ends, were used for carrying powder. These were not suitable for general merchandise purposes and were succeeded by the box cars which had iron bodies and wooden underframes. The iron sheets were ⅛ inch thick or the same thickness as the steel on the Union Pacific box cars. These cars were found to be unsuitable for general merchandise purposes or at least for commodities which might be affected by high temperatures. During the summer months they were said to be regular bake ovens. When they were withdrawn from general service and used for hauling lime-stone in bulk a great deal of trouble was caused due to sweating. When the first steel postal cars were built the metal was not covered on the interior and during cold weather more or less trouble was caused by frost gathering on the sheets inside the car. On the later cars the sheets were covered on the inside with a composition board or some similar material. If only a few steel box cars are placed in service they can, of course, be used for commodities which might not be affected by these causes, but if these features should prove very objectionable it will prevent their coming into general use even though they may be satisfactory in other respects.

The practical man with no technical school training who has made his mark in the technical field is entitled to our greatest respect. The average man of this kind is inclined to place a premium on technical education, realizing that he might have been even more successful if he had been equipped with it. Tech-

nical education does not make the man, but a young man, if he has the proper kind of stuff in him, can greatly improve his prospects by acquiring such an education. It is with considerable regret that we find a prominent manufacturer, well known in railroad mechanical circles, advising the young men and boys in his establishment, in a publication issued by his company, that it would be a waste of time and money for them to attend a technical school, and stating that he considered practically all of these schools as being gigantic humbugs.

That the railroads of this country do not take this view of the question is indicated by the fact that the greater number of them have either taken steps toward improving the condition of their apprentices and giving them at least the rudiments of a technical education, or have such plans under consideration. Not only this, but there is a demand for the young men from our technical schools, and this not alone in the drawing room, but also in the shop. Any number of these young men who have spent a few years after graduation beginning at the bottom in the railroad shop and working up, are to-day producing splendid results in assisting to cut down the cost of production and increase the output. The following extracts are reproduced from a Philadelphia dispatch dated March 9 and are of interest:

"Men with college training are to be in greater demand on the Pennsylvania Railroad henceforth. The management is making special efforts to secure apprentices who have a real technical education. The man who has it proves himself, other things being equal, to be more valuable to the railroad than the one who has been forced to get along without this training."

"We must have more college men on our lines," said one of the officials, speaking of the company's improvements and need of new men. "Of course, being a graduate is not enough in itself; there has to be ability to insure promotion. There will still be employees without the record of a day in college who will rise to the top; some men can't be kept down. But the fact remains that technical training is what a railroad man ought to have, and we intend to get those who have it."

"The percentage of college men in the service of the principal railroad systems is becoming larger every year, and such inducements as those offered by the Pennsylvania are expected to make the attraction for graduates still greater. With the traffic of the railroad increasing by leaps and bounds every technically trained man who is ready to work will be able to find a place."

PROGRESS IN TRANSPORTATION.*

By G. M. Basford.†

Macaulay realized the importance of commercial communication when he said: "Of all inventions, the alphabet and printing-press alone excepted, those inventions which abridge distance have done most for civilization." Steam has exerted a most wonderful influence upon civilization. It was really contemporaneous with the new American republic and has been most powerful in its development.

Watt completed his engine in 1787, while the Federal Convention was sitting in Philadelphia. Fifty years later Stephenson's locomotive was a success, and people now see that railroads at once became necessary. Their introduction was providential because without them these States could not have developed, and, of course, no close union of the States would have been possible. Without the railroads the Civil War might even now be dragging along because in the old days an hundred-years' war was not unheard of. The far west, the middle west and the great northwest waited for the railroads.

The vital influence of the railroad is nowhere better indicated than in the amusing senate debates of 1843, on the Oregon bill, when seen in the light of recent progress. Senator McDuffie of South Carolina ridiculed the idea of ever taking Oregon into the Union because it would require ten months for the representative to travel to the Capitol and return. Now we may go from Boston to Portland, Oregon, in less time than it took John Hancock to go from Boston to Philadelphia.

In 1783, two stage-coaches sufficed for all the transportation business by land between Boston and New York. Starting at 3:00 A. M., Providence (44 miles away) was reached at 10:00 P. M., if everything went well. The speed, we are told, depended largely upon how often the assistance of the passengers was required to lift the wheels out of the mud. We can hardly appreciate the difficulties of those days; and when we consider that Washington conducted the Revolution without the aid of railroad, steamboat or telegraph, and when we compare the military movements of that war with our latest war, we can better understand the progress that has been made.

April 13, 1907, will be the 58th birthday of the Pennsylvania Railroad. In 1846, the railroad was 20 miles long. It now has about 16,000 miles of track.

In 26 years from its inception the Atchison, Topeka & Santa Fe Railroad had grown to a total length of 10,000 miles—which is one-half that of Great Britain and Ireland, one-half that of France and Russia and two-thirds that of Germany. Its rails would reach one-third of the distance around the earth, and it has on its rolls 10,000 more men than were in the United States army at the beginning of the Civil War. Its organization is as complete as that of the United States army and is in pleasing contrast to the army in regard to internal strife and bickering.

Another form of growth is seen in the contrast between the New York Central property today and when the road from New York to Albany was owned by sixteen different companies. On January 1, 1906, fifty-four roads were combined under one operating management, as the "New York Central Lines."

In October, 1905, Mr. E. H. Harriman and party, on their way from the Orient, crossed the North American continent in a memorable trip with a rail journey of 3,239 miles, which began October 23rd, 30 minutes after 3:00 o'clock at San Francisco, and ended at 42 minutes after 7:00 o'clock on October 26th—or 73 hours, and 12 minutes later. The path included the Southern Pacific to Ogden; the Union Pacific, from Ogden to Omaha; Chicago & Northwestern, from Omaha to Chicago; Lake Shore & Michigan Southern, from Chicago to Buffalo; and Erie Railroad, from Buffalo to Jersey City. An average speed of 43.3 miles per hour was maintained across the entire continent, or 19 hours and 15 minutes faster than any previous trip from San Francisco to New York. During dinner the first evening from San Francisco the Sierra Nevada Mountains were crossed at an elevation of 7,018 feet. Great Salt Lake was crossed over the Lucin cut-off.

The entire trip of 7,775 miles from Yokohama to Jersey City was covered at an average speed of 23.7 miles per hour, including all stops and transfers. For this service between San Francisco and Jersey City thirty locomotives were required; and that such a performance, conducted without pause or delay of any kind, could be carried out with perfect comfort to the travellers, speaks volumes for the transportation organizations which were involved. Not only does it speak volumes for the organizations themselves, but for the co-operation existing between these organizations which rendered it possible for one to take up and perfect that which the previous one had brought to its hands. It will be remembered that the daughter of the President of the United States was a member of the party, and that no attempt was made in the direction of high speed. The safety and comfort of his guests was Mr. Harriman's first consideration throughout the journey.

In this development, which is the most remarkable of modern times, many lives have been spent for the benefit of others; and, that this statement is literal, may be seen by anyone who crosses the western deserts to find the graves of railroad pioneers strewing the way. To again mention the Santa Fe Railway—this line crosses mountain and desert for a large part of the way parallel and in sight of the old Santa Fe Trail; and, if the stories of this trail could be given us, it would be full of records which would stir men's blood.

We also owe much to faithful, high-minded men, some of whom are gone, who—while not directly connected with the actual development—have nevertheless been in most intimate contact with it. I refer to the technical newspaper men who played an exceedingly important part in connection with this growth

* From an address before the Technical Publicity Association, New York, on their "Steam Railroad Night." February 28th, 1907.

† Assistant to the President, American Locomotive Company.

which has become so important. We owe more to the technical papers which have devoted themselves to the field of transportation—more than is likely ever to be paid in appreciation or any other way. It is a fact, that some of the most vital features which have tended to unite and improve transportation methods in the past, originated in the offices of these papers. While conditions have changed and are changing, these influences are still strong, and the members of this Association should bear in mind these facts which have been casually mentioned.

In connection with the responsibilities of our members, it would be well to remember that there are strong technical papers in this field to-day, and papers which are earnestly directing their efforts towards advancement and improvement which will always be necessary. In dealing in a business way with these publications it is not out of place to suggest that those which really have borne the burdens of this effort, and are still bearing them, are worthy of most careful consideration.

MOTOR CARS IN FOREIGN COUNTRIES.

In an effort to ascertain the usefulness of railway motor cars to be operated in connection with the regular steam service, the Pennsylvania Railroad last fall commissioned a committee of three officials to go to Europe and see what had been done there along this line. The report of this committee which has just been submitted includes the following:

"Rail motors, costing from $8,000 to $10,000 each, have been introduced to a greater or less extent by all principal railways of England; also by several on the Continent.

"In some cases they have entirely displaced the steam passenger service on branch lines, but are generally being used for supplementary service in connection with other trains.

"The car is in charge of a guard, who issues tickets and collects fares, besides performing necessary duties in connection with the handling of luggage and parcels. He also keeps the necessary train records. On lines where motor cars are operated the freight train service is performed by a regular locomotive.

"It appears that where rail motor service has been established travel has increased to a considerable extent. Within itself, the service is not remunerative, but the expense would seem to be warranted when its value as a feeder in creating additional long-distance travel from the main line steam trains is considered.

"Operating officials of roads on which this character of service has been established were rather enthusiastic as to its possibilities. The mechanical officials, however, were not favorable to it. It was admitted that there is a slight saving in fuel, but it is claimed that this is more than offset by the increased cost of maintenance and the loss of service while undergoing repairs.

"On the Continent, while this service is in actual operation to a limited extent in Germany, France and Italy, railway officials still consider it to be in an experimental stage.

"We inspected the Great Western Railway motor service from Southall to Ealing, both stations being suburban to London. The speed ranged from twenty to forty-five miles an hour. The driver said the car was capable of fifty miles per hour. The car ran smoothly, without noticeable vibration, and had been in successful operation for three years. The London, Brighton & South Coast Railway has two gasoline motors in service at Brighton. Each car is equipped with two 30-h.p. Daimler motors suspended from the frame. Noise and vibration were noticeable while these cars were standing with the motors running. There was also a very disagreeable odor from the gasoline.

"The London, Brighton and South Coast Railway has small detachable steam locomotives at Brighton, which are attached to trailers. Local officials said this service was more satisfactory than by the gasoline cars.

"German railways, under government management, have been experimenting with rail motors two years, using for purposes of comparison a Serpollet car (steam, with coal fuel), a Milnes-Daimler car (gasoline), and an Accumulator car (storage battery), also a small locomotive and coach. We were told that the experiment so far showed the steam locomotive and coach to be the most economical and successful.

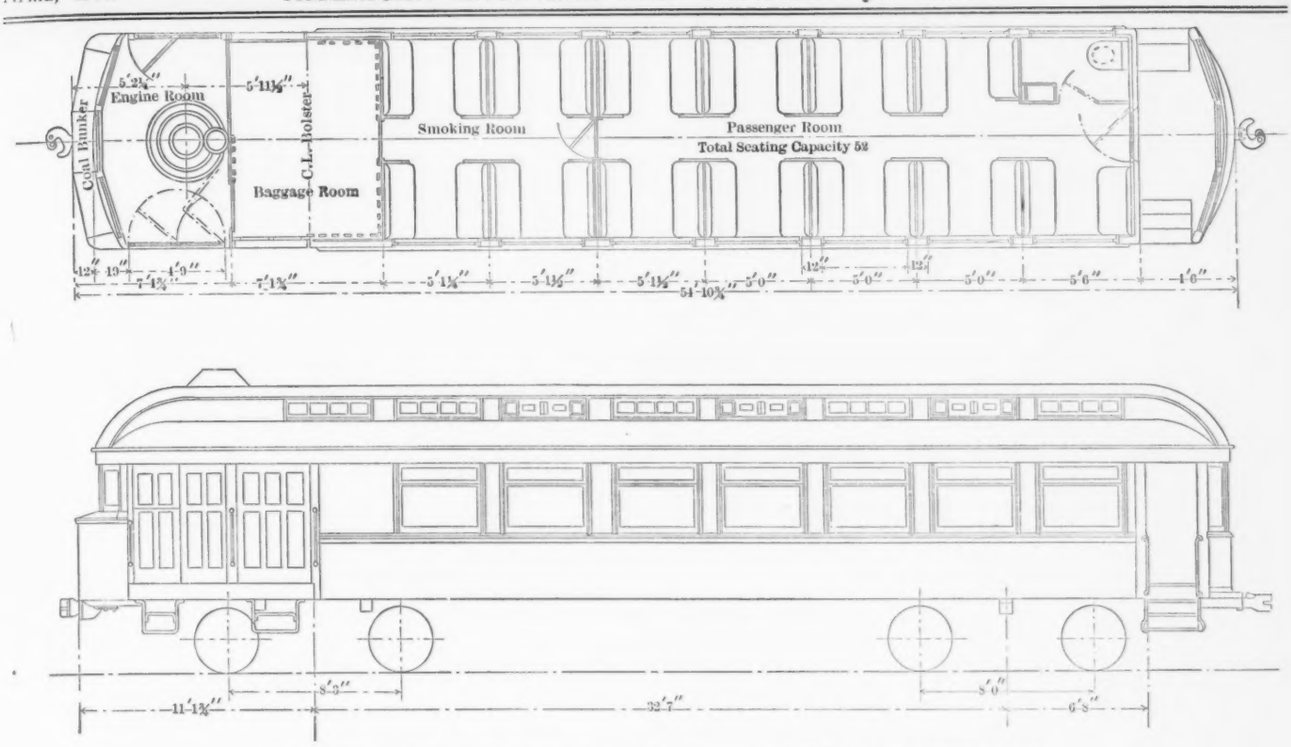
"With the benefit of this experience the committee is of opinion that the installation of self-contained motor cars for passenger service on certain branch lines largely depends upon the gradients, the possibilities for increased travel and the possible saving from a reduction in the train crews. A small tank locomotive and car, equipped for operation in either direction without turning, commends itself as the most elastic adaptation of the rail motor which came under our observation and appears to be in the line of future development abroad."

The Man, Not the System.—In my whole work on the Santa Fé I have found that system alone is not sufficient, that statistics alone are not sufficient, and, to branch away from storekeeping for a moment to a different branch, the thing that has struck me most is that in the engine it is not the type of engine, it is not the weight of engine, it is not the style of engine that counts in mechanical operation, it is the master mechanic who has charge of that engine. One master mechanic will make a light, old, half worn-out engine do better work than some other master mechanic will get out of a modern engine. The opposite is also the case. A splendid modern engine with a good master mechanic looking after it will do stupendous work, but it is not the type of engine that counts nearly as much as it is the type of man that is back of the engine, and I think that that same thing is true of storekeepers as it is of master mechanics. It is the storekeeper who counts, the man who is interested, enthusiastic and pushing in his work, and if you have that kind of a man he will evolve a system and profit by other systems, and deliver the goods.—*Mr. Harrington Emerson before the Railway Storekeepers' Association.*

Automobile Baggage Trucks.—For some time past there has been in use at the Broad Street Station of the Pennsylvania Railroad in Philadelphia, three baggage and mail trucks which are propelled by electric motors taking current from storage batteries. In general appearance they look much the same as the hand-pulled truck of large size. The batteries are mounted below the platform and the motors drive the wheels through gears. The speed is controlled by a small lever on the tongue, by which they are steered, and is so arranged that if the tongue is dropped or the operator lets go the handle, the current is shut off and the brakes applied. The operator walks ahead of the truck the same as if he was pulling it. These trucks have been very satisfactory and it is planned to add more in the near future.

Aerated Steam.—Scientific research has recently produced another and much more efficient method of increasing the thermodynamic value of the steam and its working efficiency than simple superheating. This is the Field-Morris system of what may be called the aëration of the steam by forcing into it under suitable pressure a definite and exact proportion of air, and superheating the mixture before allowing it to pass to its work in the cylinders. This mixture has been found, both experimentally and in ordinary practical working, to effect considerably more than natural steam is capable of, whether superheated or not.—*Mr. F. A. Lart in the Times Engineering Supplement.*

Railroads Which Pay Pensions.—It is said that the New York Central Lines will at an early date be included among the systems having pension departments. The list of those having these and the year in which they became effective is as follows: Baltimore & Ohio, in 1884; Pennsylvania Railroad, in 1900; Chicago & Northwestern and Illinois Central, in 1901; Southern Pacific lines, Union Pacific, Oregon Railroad and Navigation, Oregon Short Line, Philadelphia & Reading, Delaware, Lackawanna & Western, Buffalo, Rochester & Pittsburg, and Canadian Pacific, in 1903; Atlantic Coast Lines, in 1904; Atchison, Topeka & Santa Fe, Jan. 1, 1907.—*Railway World.*

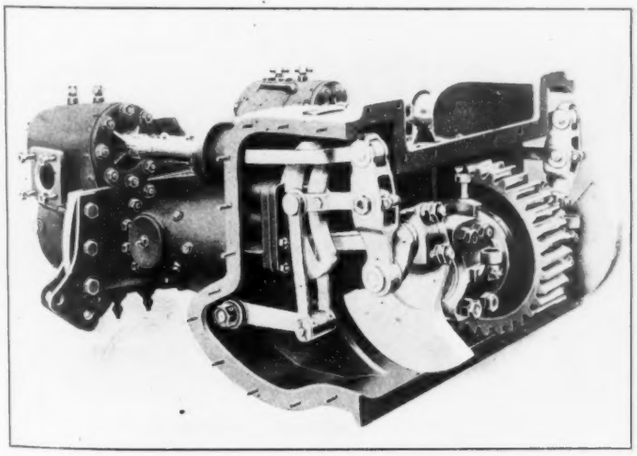


ELEVATION AND PLAN OF STEAM MOTOR CAR—CHICAGO, ROCK ISLAND & PACIFIC RY.

GANZ STEAM MOTOR CAR.

CHICAGO, ROCK ISLAND & PACIFIC RY.

The Chicago, Rock Island and Pacific Railway Co. is soon to receive a Ganz self-propelled steam motor car from the Railway Auto Car Company, New York, the American company which controls the patents and manufacturing data for the Ganz system. From the general plan and elevation shown herewith, it will be seen that it is a car having a total length over end sills of 54 ft. 10¾ in. and a seating capacity of 52 passengers, including 16 in the smoking compartment. A baggage room 7 ft. 1¾ in. long is located just ahead of the passenger compartment and ahead of this is the motorman's compartment at the forward end of the car, which contains the generator and accessories, and is 6 ft. 4¾ in. long over all. The coal bunker is supported over the front end sill and the coal is removed through a small sliding door opening into the motorman's compartment. The coal bunkers carry sufficient fuel for a continuous run of 50 miles.



STEAM MOTOR IN GANZ MOTOR CARS.

The feed water for the steam generator is carried in two longitudinal steel tanks suspended from the underframe of the car. These tanks have a total capacity of 600 gallons or sufficient for a continuous run of about 60 miles. The steam generator, of the standard Ganz type, is 42 in. outside diameter. This steam generator is capable of developing a maximum of 120 h.p. in conjunction with the compound steam motor which is mounted in the forward truck and drives on the rear axle thereof.

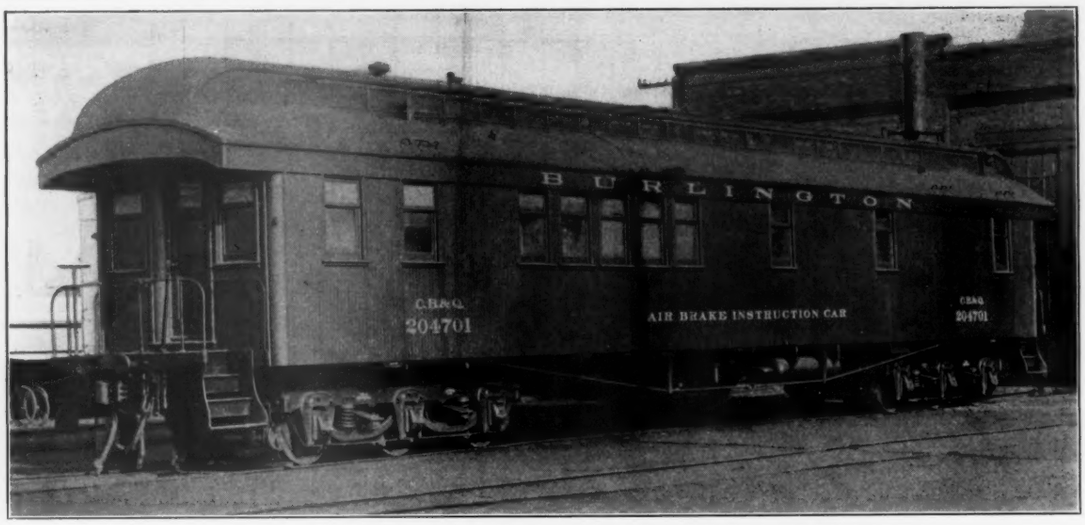
A view of the steam motor with the cover enclosing the gears and link motion removed is given in one of the illustrations. This motor has compound, steam-jacketed cylinders, and is entirely enclosed. The gear case is partly filled with oil, so that all moving parts receive a continuous and thorough lubrication. The normal speed is 600 revolutions per minute, although it can be operated satisfactorily up to a speed of 900 revolutions per minute. The working pressure is 270 pounds per square inch, the steam being superheated. The motor is controlled entirely by levers conveniently located at the right-hand side of the motorman's compartment.

The car body is of all steel construction with the interior finished in quartered oak. The general scheme of design of the car body is the same as is used on most of the all-steel passenger coaches, which have been, or are being, built, i. e., the vertical load of the car and its lading is carried by the sides of the car below the belt rail, which are in the form of deep plate girders, while the buffing strains are taken care of by relatively light longitudinal center sills. The total weight of this car in working order fully loaded is 36 tons. The car is equipped with Westinghouse automatic brakes, the air compressor being of the axle driven type and mounted in the trailer truck.

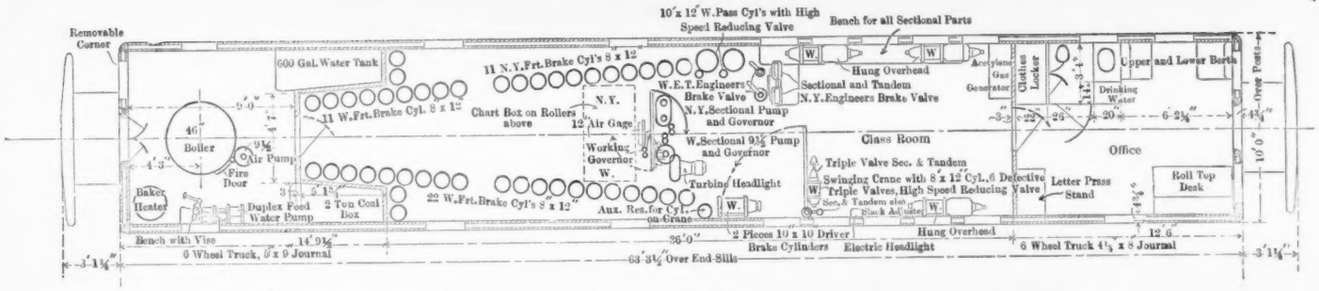
The car is designed to maintain a speed of 35 miles an hour on a level track, 24 miles an hour on a 1 per cent. grade and 15 miles an hour on a 1½ per cent. grade. It is also capable of hauling a trailer at a speed of 30 miles per hour on a level track. and 15 miles an hour on a 1 per cent. grade. The fuel is to be coke and the consumption is not to exceed 16½ pounds per mile.

This is the first standard car of the Railway Auto Car Company to be built and delivered in this country, although orders for other cars of this general type are now being executed.

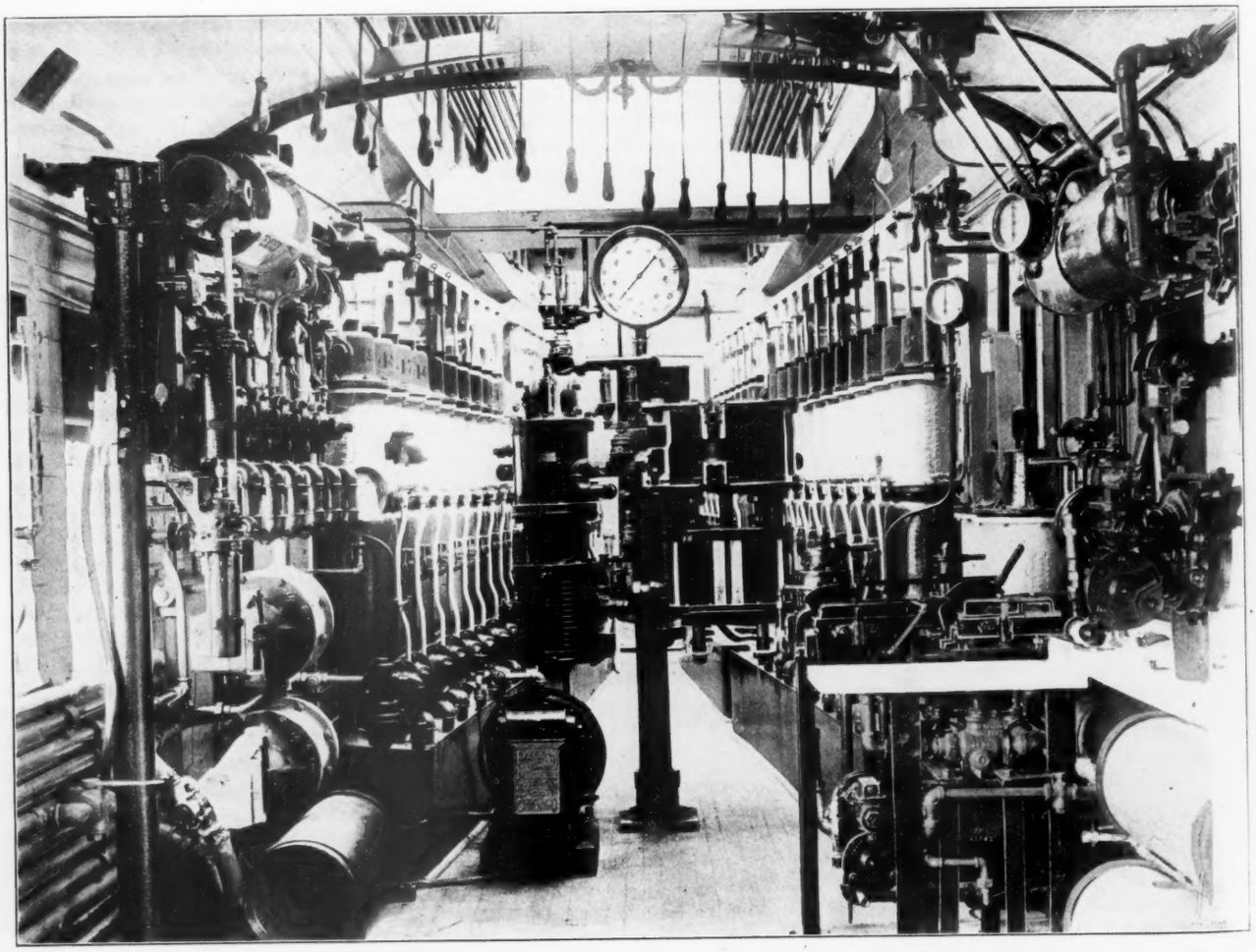
ROLLING STOCK OF THE PENNSYLVANIA.—Between the years 1899 and 1906, inclusive, there were 1,216 new locomotives added to the equipment of the Pennsylvania System, and 1,337 locomotives rebuilt, all of which increased the total tractive effort from 73,200,000 to 166,100,000 lbs. During the same time there were 122,718 freight cars built or rebuilt, giving an increase of 4,927,000 tons in loading capacity.



AIR BRAKE INSTRUCTION CAR—CHICAGO, BURLINGTON AND QUINCY RY.


Removable Corner
600 Gal. Water Tank
11 N.Y.Frt.Brake Cyl's 8 x 12"
10"x 12" W.Pass Cyl's with High Speed Reducing Valve
Bench for all Sectional Parts
Hung Overhead
Sectional and Tandem N.Y.Engineers Brake Valve
W.E.T.Engineers Brake Valve
N.Y.Sectional Pump and Governor
Acetylene Gas Generator
Clothes Locker
Upper and Lower Berth
Drinking Water
11 W.Frt.Brake Cyl. 8 x 12"
Chart Box on Rollers above
N.Y. 12" Air Gage
Working Governor
W.Sectional 9½ Pump and Governor
Class Room
Office
Boiler
Air Pump
Fire Door
Triple Valve Sec. & Tandem
Swinging Crane with 8 x 12" Cyl.,6 Defective W. Triple Valves,High Speed Reducing Valve
Letter Press Stand
Roll Top Desk
Baker Heater
Duplex Feed Water Pump
2 Ton Coal Box
22 W.Frt.Brake Cyl's 8 x 12"
Aux. Res.for Cyl. on Crane
Turbine Headlight
Bench with Vise
6 Wheel Truck, 6 x 9 Journal
2 Pieces 10 x 10 Driver Brake Cylinders
Electric Headlight
6 Wheel Truck 4½ x 8 Journal
63'3¼" Over End Sills

FLOOR PLAN OF AIR BRAKE INSTRUCTION CAR.



INTERIOR VIEW OF AIR BRAKE INSTRUCTION CAR—CHICAGO, BURLINGTON AND QUINCY RY.

AIR BRAKE INSTRUCTION CAR.

Chicago, Burlington & Quincy Railway.

The Chicago, Burlington & Quincy Railway has just completed at its Aurora shops, a new air-brake instruction car, which contains many points of interest, especially in connection with the best location and arrangement of the apparatus.

Reference to the illustration will show that the car contains a most complete instruction equipment for both the New York and Westinghouse systems, as well as for electric and acetylene lighting systems. The view showing the floor plan taken in connection with the interior view of the car, will show that by careful study a very large amount of apparatus has been collected into a small space in such a manner that practically all the parts needed for instruction on any particular point can be brought into clear view of the men seated in the class-room. This will permit the proper and convenient instruction of the men without necessitating their following the instructor to various points of the car for demonstration of particular details, thus not only facilitating but also improving the results of the instruction.

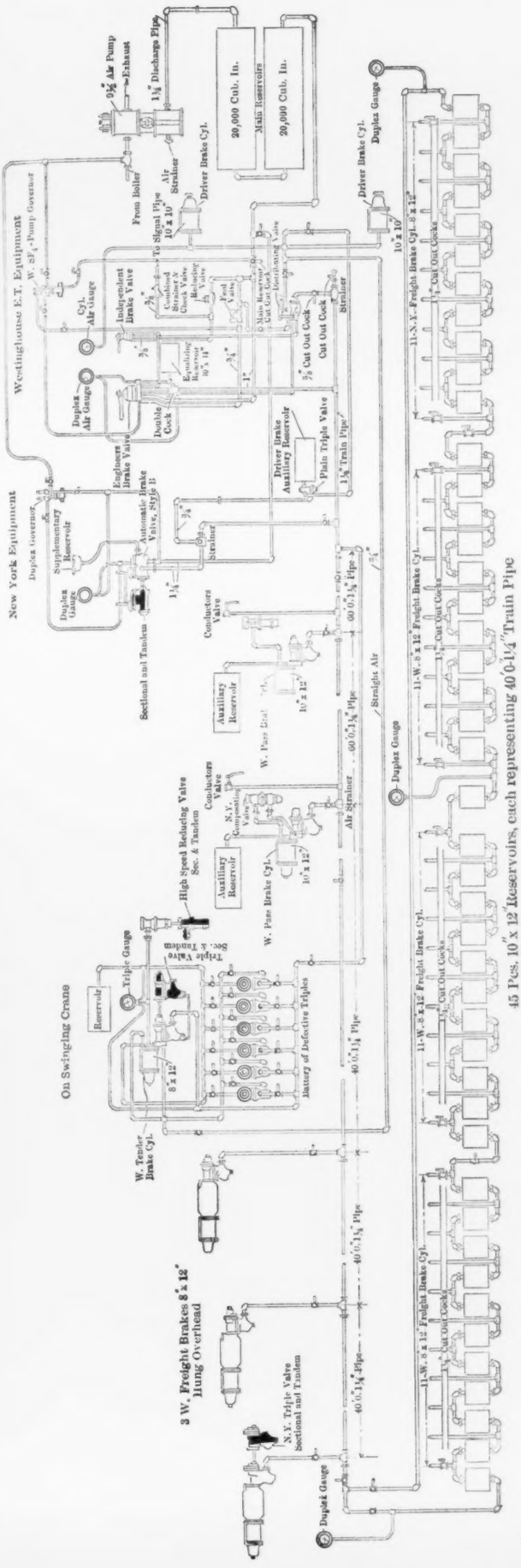
The car body, which was converted from a mail car, is divided into three compartments—an office 12 ft. long; a class-room 41 ft. long, and a boiler-room 9 ft. long. The office is arranged with a roll-top desk; upper and lower berths; wardrobe and toilet room. Above the desk is placed a triplex gauge for indicating the train line, signal line and brake cylinder pressures underneath the car. The boiler-room contains a 40-in. vertical boiler carrying 200 lbs. pressure and equipped with shaking grates and an extension smokestack. Water is supplied from a 600-gallon water tank by either an injector or a duplex pump. A 9½-in. air pump, which supplies air for the apparatus in the class-room, is attached to the boiler. A Baker heater is included for warming the car. A coal-storage space, with a capacity of 2 tons, is located on the oposite side of the car from the water tank.

In the forward end of the class-room there is space for 18 men to be seated on folding chairs. The 52 brake cylinders, consisting of 36 Westinghouse 8 x 12 freight brakes; 11 New York 8 x 12 freight brakes; 2 Westinghouse 10 x 12 tender brakes, and 2 Westinghouse 10 x 10 driver brakes, are all in full view from the seats in the class-room. The freight brakes stand vertically in two rows on either side of the car, the rows converging toward the boiler end for the purpose of bringing the piston rods in clear view. The other brake cylinders are mounted horizontally below the lower deck, where they can be easily seen. One tender brake cylinder and connections is bolted to a swinging crane, on which is also mounted six triple valves having various defects, any one of which can be connected to the cylinder. On the interior view this crane is shown swung against the left wall of the car. To the cylinders that are set in a vertical position, the triple valves are attached by means of a special elbow, which brings them into a horizontal position, the same as they occupy underneath a car.

To do away with the large amount of piping usually found in an instruction car, for representing the train line, 45 of the brake cylinders are connected to 10 x 12 in. equalizing reservoirs, which have practically the same capacity as a 40 ft. 1¼ in. train pipe, and have been found to give the same results as that amount of actual piping. These are placed on the floor and are enclosed in a galvanized iron casing.

As can be seen from the illustration showing the piping connections, the brakes can be operated in various combinations, either by the Westinghouse E. T. system, or by the New York system. Practically all operating features of both systems are connected in tandem with a sectional part, so that the interior workings can be easily demonstrated. Some of this apparatus is hung on swinging cranes in the centre of the car, where it can be brought into view when needed.

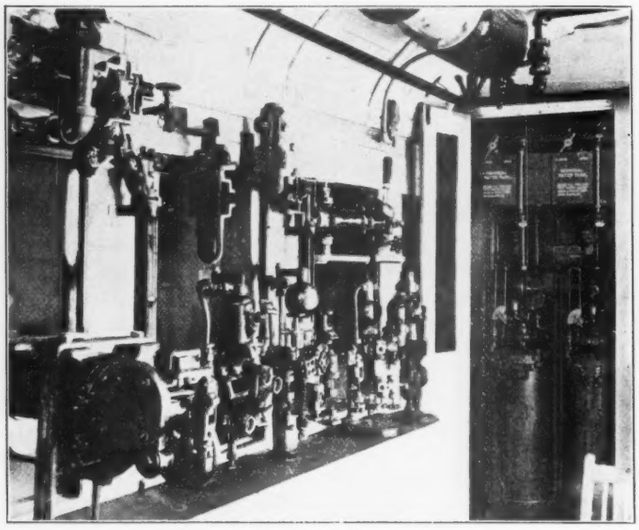
The air signal apparatus consists of a complete equipment for fourteen 60-ft. cars, the piping being placed along each side of the clere story. The signal cord handles will be noticed in the interior view.



PIPING DIAGRAM OF AIR BRAKE INSTRUCTION CAR—CHICAGO, BURLINGTON AND QUINCY RY.

Colored Westinghouse and New York diagrammatical charts are mounted in a case, which, when in use, can be lowered in front of the class and at other times is secured against the roof.

A bench is provided on which are placed the sectional parts of air-brake apparatus, lubricators, injectors and steam-heat apparatus. The car is also equipped with Pyle electric light apparatus and the Adlake acetylene lighting outfit, both of which



SECTIONAL PARTS AND ACETYLENE GENERATORS.

are complete, and while installed primarily for demonstration are also used for lighting.

The interior of the car is finished with light drab walls and white ceiling, which taken in connection with the black demonstrating apparatus, gives a most pleasing interior appearance. It it carried on two six-wheel trucks, the one under the boiler, which carries the larger part of the weight, having 5 x 9 in. journals and the one under the office end having 4¼ x 8 in. journals.

THE TALLEST OFFICE BUILDING.—The Metropolitan Life Building at Madison Square, New York City, is having an annex or addition built to its present eleven-story building which will include a tower 658 feet high, having forty-eight stories in all. For the first eleven stories the addition covers an area of 153 x 75 ft. From this to a point 492 ft. above the ground the tower will be 75 x 85 ft. in plan. Above this a pyramidal structure will extend 94 ft. high, the whole to be surmounted by an octagonal cupola 70 ft. high. The completed building will have a total floor area of 1,085,663 sq. ft., or about 25 acres.

THE RECESSION OF NIAGARA FALLS.—A pamphlet recently issued by the U. S. Geological Survey states that the rate of recession of the Horseshoe fall, or the rate of lengthening of the Niagara gorge, during the 63 years from 1842 to 1905 is found to be 5 ft. per annum, with an uncertainty of 1 ft. For the 33 years from 1842 to 1875 the rate was apparently slower than for the 30 years from 1875 to 1905. The rate of recession of the American Fall during the 78 years from 1827 to 1905 was less than 3 inches per annum. The present and prospective diversions of water for economic uses interfere with the course of nature and may be expected to modify the future rate of recession.

PRESENT REPAIR SHOP REQUIREMENTS.—A man who formerly took a small engine into the shop once in two years and gave it an overhauling in two months must now, in order to play even, take twice as heavy an engine into the shop once a year and do twice the work in 30 days. If in addition he is to do better than he formerly did, if he is to improve as much as the engine in capacity, he must repair it in 15 days, therefore do twice the work twice as often in one-quarter the time. This is not an impossible task, since some shops are doing it, but they are exceptions.—*Harrington Emerson in the Railway Age.*

TONNAGE RATING.*

BY F. W. THOMAS.

In each step in the advancement of the size and hauling power of locomotives each new engine is expected to do a great deal more than its immediate predecessor, often a great deal more than it can do, and generally the traveling engineer has to explain why it would not do better. In every endeavor to make these engines haul what was expected of them we have gradually increased the load, increased the time over the division and decreased the speed until it is a rare thing that we see a freight train moving faster than seven miles an hour over the controlling grades, where they formerly made as high as fifteen to twenty.

On account of the increase in salaries of our officers, the increase in pay for the men who run the engines, the increase in the cost of material and the increase in interest charges, it has been necessary to take advantage of every opportunity offered to see that each engine is given all it can pull over the division and yet at the same time keep the traffic moving.

The methods of rating engines are as various as the roads in the country. Each road appears to have a method of its own, and the writer will only give the methods with which he is familiar, leaving it for each of you to discuss this subject and your own method of rating engines.

The method used by the Santa Fe System in rating engines is first to ascertain the theoretical rating; after this has been done, a

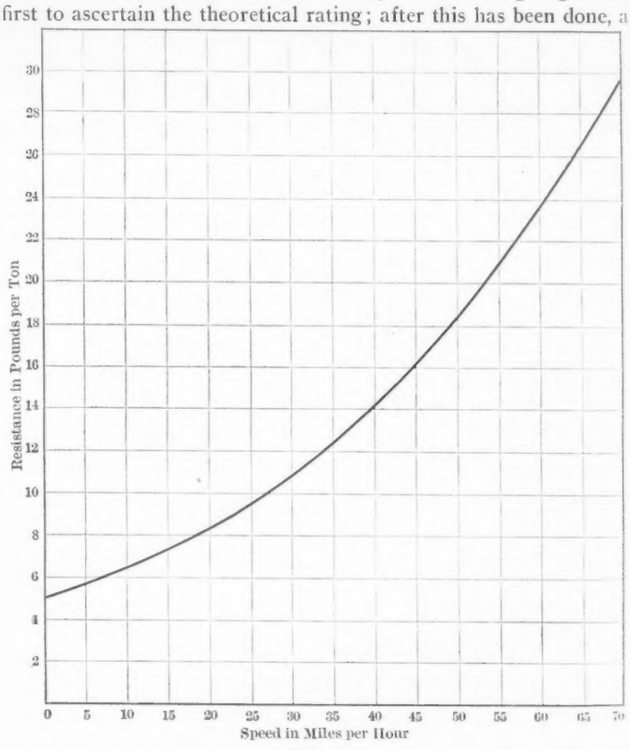


FIG. I.

representative of the test department in company with the traveling engineer and train master will prove this rating by actual test, using engines of different classes. After the practical test has been made and any or all errors corrected for the class tested, the remaining classes of engines on the district are pro-rated according to their tractive power.

The most difficult problem after the rating has been ascertained and proven, is to express the rating intelligently and in such a form that the dispatchers, yard masters, foremen or switch crews and conductors can understand and easily interpret the rating sheets.

The most difficult thing to impress upon those interested is the fact that the rating is often governed by the number of cars in the train; the greater the number of cars, the greater the rolling resistance. In the eyes of the average train master and dispatcher a thousand tons, whether confined in twenty cars or in fifty, is a thousand tons.

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* From a paper presented at the fourteenth annual convention of the Traveling Engineers' Association, 1906.

The train master in his daily report shows the tonnage of each train handled over his territory and on the same report he must show the maximum tonnage rating. The earlier rating sheets only show two ratings, one for loads and one for empties. It has been our object to prepare a sheet which will show the correct rating for engines, whether heavy or light loads, or whether all loads or all empties. The rating given for a certain number of cars will be the maximum rating for the engine for the given number of cars.

Figure 1 is a curve showing rolling or frictional resistance in pounds per ton for speeds. Figure 2 shows decrease in tractive power with increase in speed. Figure 3 shows methods of expressing tonnage rating, a booklet for each division, and a page for different tonnage districts.

Referring to Figure 3, this rating is shown for cars weighing fifty tons down to cars weighing sixteen tons. By using this rating sheet the train master in his daily report shows that his train came in with so many cars and certain tonnage; by referring to the rating sheet it will show what the rating should have been for that number of cars, and this rating will be the maximum rating for that engine. You will note on the same chart that the maximum rating is shown in cars weighing fifty tons, and for every car added to the train above this given number of cars a reduction from the maximum rating must be made of from four to five tons. The four-ton reduction is generally made on a division where the track is generally straight and the five-ton reduction is made on a division where the curves are more pronounced and where prevailing winds are encountered. I cannot say that this reduction is based on any fixed rule, beyond, as

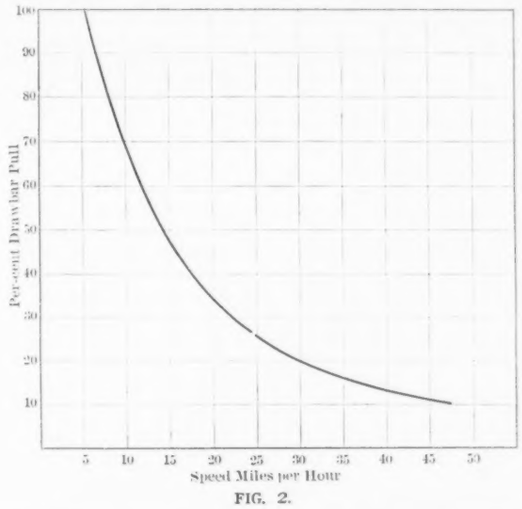


FIG. 2.

mentioned above, that it is the fruit of long investigation and a series of tests, and is often controlled by local conditions.

We have found in each case where the rating is so made and shown, if lived up to, there is a great deal of the disagreeable taste resulting from this tonnage rating business, eliminated. We find that an engine can pull its rating in sixteen-ton cars as easily as it can pull its rating in fifty-ton cars, and this is one of the secrets of properly rating engines.

As a basis for calculating the maximum rating we start out with a resistance of five pounds per ton rolling or frictional resistance, twenty pounds per ton for each per cent. of grade, and one-half pound resistance for each degree of curvature, where the curves are compensated for forty-five miles per hour speed. Now for the minimum rating we allow the same for grades and for curvature as with the maximum, but for the rolling resistance we allow 8.5 to 10 pounds per ton, so with an engine of 40,000 pounds tractive power, weighing 160 tons, we find on a one per cent. grade that it could pull 1,270 tons. The analysis of the total resistance is five pounds per ton for frictional resistance, twenty pounds per ton for grade, and where the maximum curve is six degrees we would have three pounds for curvature, giving a total resistance of twenty-eight pounds per ton. This into the tractive power gives a total tonnage of 1,430, and subtracting the gross weight of the engine and tender in working order, 160 tons, we will have 1,270 tons, the maximum hauling capacity of the engine with fifty-ton cars. Now with empties, or sixteen and two-third-ton cars, we have a tonnage of 1,110. The minimum rating of 1,110 for sixty-four cars will be a difference of 160 tons, so the rating for this engine should be shown in the following manner: 1,270 tons in twenty-five cars; 1,262 tons in twenty-eight cars; 1,246 tons in thirty-two cars, and so down to 1,110 in sixty-four cars. This formula is for the maximum power of the engine at a speed of from five to seven miles an hour on the hardest pulls. Should it be desirable to run at a faster speed than this, you must first establish the maximum speed at which you wish to move, that is over the controlling grade, and in addition to the resistance mentioned above you should add to it the resistance due to increased velocity, as shown on the curve No. 1. The above figures are for favorable conditions—favorable as to condition of engine and favorable weather.

Another factor entering into the resistance column, very often the controlling one, is the wind resistance. This factor, I regret to state, has not been satisfactorily adjusted anywhere, although we all know that a quarter wind offers the greatest resistance. Still on account of the variety of cars composing the average freight train it is impossible to fix any set percentage of reduction.

Another factor which enters the resistance column is the tem-

WESTERN DIVISION INDEX

1st District	Page 1, 2, 3, 4
2nd District	" 5,
3rd District	" 6, 8
4th District	" 6, 7, 8
Great Bend District	" 9
Larned District	" 10

The weight of train should never exceed the tonnage opposite the number of cars. Caboose counted as one car, 18 tons.

WESTERN DIVISION 7

Tonnage District	No. of Cars	Class of Engine: 151 221 261 / 283 315 317 354	507	468	1050	1200	825			
		TONS								
Caddoa to Hilton	19	950	(21)	(22)	....	....	....	....	....	....	....
	20	946	1050	1100	....	....	....	....	....	....	....
	24	930	1046	1092	(29)		....	....	....	....	..
	28	914	1030	1076	1450	(34)	1500	....	....	....	....
	32	896	1014	1060	1438	1700	1492	....	....	....	....
	36	876	996	1044	1422	1692	1476	....	....	....	....
	40	856	976	1026	1404	1676	1460	2000	....	....	....
	44	831	959	1008	1384	1658	1440	1984	....	....	....
	48	816	931	988	1365	1640	1420	1968	....	....	....
	52	(49)	916	968	1343	1620	1400	1950	....	....	....
	56	....	(55)	948	1325	1600	1375	1942	....	....	....
	60	....	....	(57)	1300	1575	1350	1922	....	....	....
	64	....	....	....	1275	1550	1325	1900	....	....	....
	68	....	....	....	1250	1525	1300	1875	....	....	....
	70	....	....	....	1225	1500	1275	1850	....	....	....
	..	....	....	....	....	....	....	....	....	....	....
	..	....	....	....	....	....	....	....	....	....	....

FIG. 3.

perature. In the extreme southern section of the country where the temperature is even throughout the entire year or never below the freezing point, it is not necessary to take into consideration the temperature, but in the colder climates where the prevailing temperature in winter is below the freezing point we find it is necessary to make considerable reduction. It is a custom of the Western roads and some of the divisions on the Santa Fe System, to make a reduction of ten per cent. between the months of November and April under favorable winter conditions. But it has been our experience for a frosty or wet rail to make a seven per cent. reduction, from thirty-two degrees down to zero Fahrenheit make a ten per cent. reduction, and from zero below to make a twenty per cent. reduction.

In addition to this we have another reduction which the writer thinks should be made, but at the same time it is a very delicate question, namely, the reductions on account of the condition of

the engine. We feel sure that were any road to simply make a reduction on the condition of the engine, there would be a continual warfare between the mechanical and transportation departments, unless the condition be based on the mileage the engine makes and allowance for the time the engine has been out of the shop; nor are we aware of any road that allows any reduction to be made on account of the condition of the engine. We do believe, however, that the reductions should be made for the condition of the engine, that is, the master mechanic and traveling engineer should say what is the condition of the engine, and each engine should be placed under a certain class or number of condition rather than the time that it has been out of the shop. I would say the engines should be divided into three classes. If an engine is in good condition and good for maximum tonnage, we will call it A class; when it reaches a certain condition a reduction of ten per cent. should be made and we will call this class B, and then the third class with a twenty per cent. reduction, which we will call C. After this the engine should go to the shop, for it does not pay any road to keep an engine in service if it is necessary to reduce the tonnage below 20 per cent. of the regular rating.

Until the roads adopt or the officials stamp their approval upon a scheme of this nature, tonnage rating will continue to have a disagreeable drawback.

Recent tests which the writer has made with cars equipped with ball or roller center and side bearings, proved that with the modern roller or ball bearing an increase of about seven per cent. tonnage can be hauled over divisions having a number of curves; in other words, on a six-degree curve the engine could start fully 100 tons more in cars having roller bearings than in cars having ordinary slide bearings.

While in motion, a train moving eight or nine miles an hour on a tangent with the common slide bearing the speed of the train would reduce from one and one-half to two miles an hour when pulling around curves; with roller bearings the speed would be reduced only three-fourths to one mile an hour. This slight increase of speed would allow the train with the roller bearings to attain a higher speed on a straight track, pick up speed on short tangents, and approach the next curve with a greater momentum.

We all are aware that there are very few trains of the same number of cars and the same weight which will pull alike. The writer, when making some tonnage tests on mountain divisions, got along nicely with the maximum theoretical tonnage with one set of cars; but on the second trip with the same weather conditions, same engine, same number and class of cars, and with fifty tons less tonnage, actually stalled and was unable to pull the tonnage over the same territory.

We have always been able to pull nearer the maximum tonnage with compound engines than with the simple engines. It is our custom to give simple engines a lighter rating than compound engines.

With the simple engines when they stall it is a matter of doubling the hill; with the compound engines we always have the "Big Gun" or the simpling lever to fall back upon to tide us over the critical point.

There is one point in reference to tonnage rating that I wish to dwell on for a moment; it does not particularly injure an engine to pull its tonnage, although it is a little harder on the cylinder and frame to work at full capacity. At a speed of six to seven miles an hour it is not as hard as it is when running at a higher speed, for more power is developed at a higher speed (evaporation is greater, fuel consumption per hour is greater) than will be developed at seven miles an hour. The engine will burn more coal per hour when running at fifteen miles per hour than when running at seven miles an hour. It is true the total consumption over a division is greater on account of being on the road longer; but what does the injury is to have the engine out for such long hours—the engine crew become worn out, the water in the boiler becomes foul, the fire-box becomes dirty, causing an irregular steam pressure, resulting in leaky flues, etc. This one thing is more harmful to an engine than the fact that it is pulling heavy tonnage.

We advocate that where the division is 100 to 110 miles in length the full rating should be given the engine; but where the division is longer the rating should be decreased in consideration of the length of the division. Not a decrease proportionally, but decreased sufficiently in order that the total time over the division should be reasonably close to the time over the division 100 to 110 miles in length with full tonnage.

The full engine rating can be hauled cheaper on a double track than it can be hauled on a single track. For where there is a road with sufficient business to move their engines on a tonnage rating basis there are always sufficient trains to cause considerable delays. However, a good deal of the expense of pulling in and out of sidings is eliminated by roads having two or more tracks.

We do think that on roads where traffic is sufficiently heavy to cause twenty-five to fifty per cent. delays in taking siding and getting orders, fully ten per cent. reduction from the maximum rating should be made. Such reductions would enable the engine to make faster time betwen stations and consequently shorten the time that it would be on the road. We believe also that over divisions where the grades are undulated the engine should be loaded nearer the maximum rating than over those divisions where the controlling grades are ten, fifteen and more miles in length.

On the undulated grades where the maximum pull is only three to four miles in length the momentum will enable you to cover the first mile in good time, and leave you only two or three miles to be gone over with drag speed. Whereas over the divisions where the grades are longer sufficient reductions should be made to enable the engine to go up these grades at a faster speed than the speed which it would otherwise make with the maximum rating.

Higher Cutting Speed with an Intermittent Cut.—An intermittent cut has a very different effect upon cutting speed from that produced by chatter. We have observed in a large number of cases that when a tool is used in cutting steel with a heavy stream of water on it (and this is the proper method of cutting steel of all qualities), a rather higher cutting speed can be used with an intermittent cut than with a steady one. The reason for this is that during that portion of the time when the tool is not cutting, the water runs directly on those portions of the lip surface and cutting edge of the tool which do the work, and for this reason the tool is more effectively cooled with intermittent work than with steady work. As an example of intermittent work, the writer would cite:

a. Cutting the outside diameter of a steel gear wheel casting, in which case the tool is only one-half its time under cut.

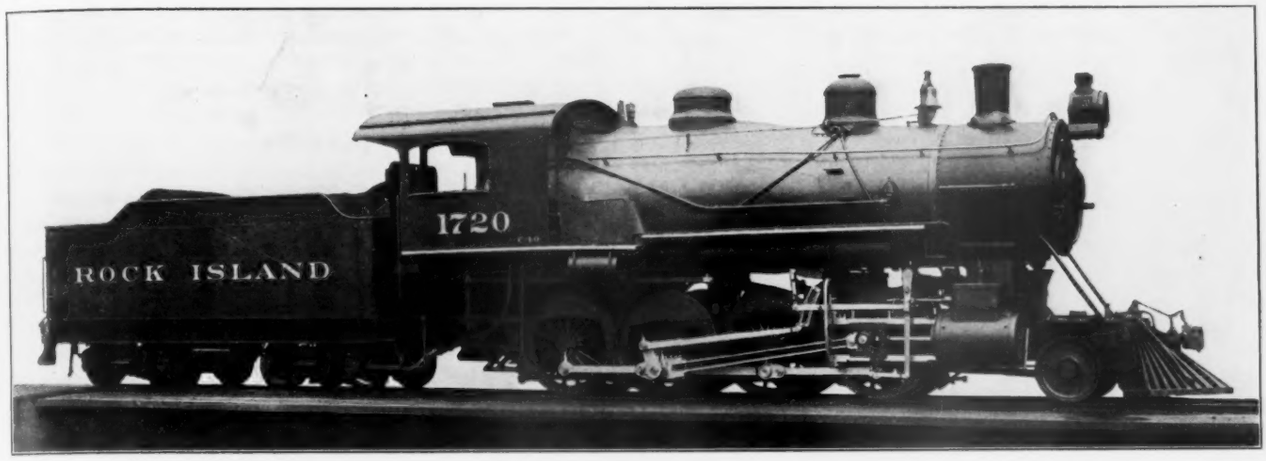
b. Or turning small pieces of metal which are greatly eccentric.

c. Or, for example, all planer and shaper work which is not too long.

It would seem from a theoretical standpoint that a tool would be greatly damaged (and therefore a slow cutting speed would be called for) by the constant series of blows which its cutting edge receives through intermittent work. It will be remembered, however, that in planer work (and this class of intermittent work comes to the direct attention of every machinist) the tool is more frequently injured while dragging backward on the reverse stroke of the planer than it is while cutting, and it is very seldom that a tool is damaged as it starts to cut on its forward stroke. In all cases, however, where the tool deflects very greatly, when it starts its cut on intermittent work slower speeds are called for than would be required for steady work.

The above remarks on intermittent work do not of course apply to cast iron with a hard scale or the surface of which is gritty. It is evident that in all such cases owing to the abrasive action of the sand or scale on the tool, intermittent work is much more severe upon the tool than a steady cut.—*Mr. Fred W. Taylor, before the Am. Soc. Mech. Engrs.*

Pension Fund Increased.—The annual appropriation of the Pennsylvania Railroad to its pension fund for retired employees has been increased from $300,000 to $600,000. There are now 1,940 men on the pension rolls of the company.



SIMPLE CONSOLIDATION LOCOMOTIVE WITH WALSCHAERT VALVE GEAR—CHICAGO, ROCK ISLAND & PACIFIC RAILWAY.

SIMPLE CONSOLIDATION LOCOMOTIVE.

CHICAGO, ROCK ISLAND & PACIFIC RY.

The Baldwin Locomotive Works recently completed the delivery of an order of 83 large consolidation locomotives for the Chicago, Rock Island and Pacific Ry. These locomotives have large, simple cylinders, large drivers and a boiler pressure of 185 lbs. and indicate the recent tendency of building very powerful freight locomotives with comparatively large drivers to handle heavy trains at higher speeds than was previously considered economical. The low boiler pressure is in keeping with the results obtained by Dr. Goss in his experiments* and has been standard on the Rock Island for all types of locomotives except the Pacific, for several years. The boiler in this case is designed for 200 lbs. pressure and that pressure can be used in certain districts where a larger boiler capacity may be needed.

Balanced slide valves operated by a Walschaert valve gear are used. The center lines of the steam chests are 3½ inches inside the center of the cylinders, which necessitated the use of a rock shaft to transfer the motion from the plane of the valve gear which, of course, is outside the center line of the cylinders. This rocker arm is supported on a frame cross brace just back of the cylinders and has both arms extending downward. The outer arm connects directly to the top of the combination lever and the inner arm drives the valve stem through a crosshead connection, the valve stem being guided by a bracket supported on the top guide bar.

The frames are of cast steel, with double front rails, and measure 5 inches wide throughout. The equalization system is broken between the second and third pair of driving wheels. The loads on the third and fourth pairs of wheels are equalized through beams placed over the boxes, with an inverted leaf spring between, and coil springs front and back.

The boiler is of the extended wagon top type with a radially stayed firebox. The mud ring is 5 inches wide on all sides and the water space rapidly increases in width toward the crown sheet. The outer side sheet is vertical while the firebox side sheet slopes inward. The back head and throat sheet are sloping, the throat being rather shallow. The heating surfaces and boiler ratios are given in the accompanying table.

The tender has a steel frame and capacity for 7,000 gals. of water and 12 tons of coal.

The general dimensions are as follows:

GENERAL DATA.

Gauge	4 ft. 8½ in.
Service	Frgt.
Fuel	Bit. Coal
Tractive effort	39,500 lbs.
Weight in working order	198,600 lbs.
Weight on drivers	177,300 lbs.
Weight on leading truck	21,300 lbs.
Weight of engine and tender in working order	238,900 lbs.
Wheel base, driving	17 ft.
Wheel base, total	26 ft.
Wheel base, engine and tender	58 ft.

RATIOS.

Weight on drivers ÷ tractive effort	4.5
Total weight ÷ tractive effort	5
Tractive effort × diam. drivers ÷ heating surface	960
Total heating surface ÷ grate area	5.2
Firebox heating surface ÷ total heating surface, per cent	6.5
Weight on drivers ÷ total heating surface	67
Total weight ÷ total heating surface	77
Volume both cylinders	14.4 cu. ft.
Total heating surface ÷ vol. cylinders	180
Grate area ÷ vol. cylinders	3.47

CYLINDERS.

Kind	Simple
Diameter and stroke	23 x 30

VALVES.

Kind	Bal. slide
Greatest travel	5½ in.
Gear, type	Walschaert

WHEELS.

Driving, diameter over tires	63 in.
Driving journals, main, diameter and length	10 x 12 in.
Driving journals, others, diameter and length	9 x 12 in.
Engine truck wheels, diameter	36 in.
Engine truck journals	6 x 12 in.

BOILER.

Style	E. W. T.
Working pressure	185 lbs.
Outside diameter of first ring	74 in.
Firebox, length and width	107 x 67¼ in.
Firebox, water space	5 in.
Tubes, number and outside diameter	340-2 in.
Tubes, length	15 ft. 6 in.
Heating surface, tubes	2,427 sq. ft.
Heating surface, firebox	168 sq. ft.
Heating surface, total	2,595 sq. ft.
Grate area	50 sq. ft.
Smokestack, height above rail	15 ft. 7 in.
Center of boiler above rail	9 ft. 9 in.

TENDER.

Frame	Steel
Weight, light	58,000 lbs.
Wheels, diameter	33 in.
Journals, diameter and length	5½ x 10 in.
Water capacity	7,000 gals.
Coal capacity	12 tons

* See AMERICAN ENGINEER, January, 1907, p. 13.

THE CARD INDEX—ITS ADVANTAGES.—Briefly, the card index then has the following advantages:

Accessibility—always get-at-able—nothing is buried and lost.

Time-saving—for the searchers after information.

Expansibility—only one end, the beginning. Can enlarge forever and still be as good.

Order—new material inserted into exactly the proper place.

Adaptability—suits every frame of mind, and every sort of business; varied classification.

System—encourages system in vast accumulating data and brings it under general heads of classification.

Divisibility—some cards can be removed for temporary use elsewhere, or for permanent transfer.

Labor-saving—nothing has to be rewritten, saves clerical labor.

Simplicity—can be operated by the inexperienced.

Contractibility—no need of retaining useless, outgrown matter.

No wasting of spaces—it is impossible to apportion blank spaces in books so that they will fill evenly.

Always being up to date.

Rearrangement made easy.

Substitute for memory—supplementing it and becoming independent of existing hired memories.

Classifications within the index—by using tab cards.—*Prof. H. Wade Hibbard.*

PRACTICAL MEANS FOR INCREASING THE EARNING CAPACITY OF FREIGHT CARS.*

By J. E. Muhlfeld.†

Design and Construction.—Compact train loads increase and accelerate movement, by reducing the cost for switching and transporting traffic. Therefore, in the design and construction of a freight car it is advisable to arrange for the maximum volume and weight of lading per lineal foot of track space and for the quick loading and unloading of the greatest variety of commodities.

While convertible features should not be embodied in equipment to an extent that would result in extraordinary first or maintenance cost, a limited number of practical arrangements, such as movable floors, ends and sides may be combined to provide a car suitable to carry and dump lading such as coal, ore, dolomite, sand and similar material into manufacturing plants and to be loaded with billets, pig iron, pipe, plate, structural steel and other commodities, thereby enabling it to carry freight both coming and going, thus reducing the light car mileage to a minimum.

Wood should be used in freight car construction only where it is required to provide for the cleating and otherwise bracing and building up of certain classes of lading and where metal would not insure the proper insulation against heat or cold.

Steel plates for horizontal flooring should be made of sufficient thickness to prevent early depreciation due to corrosion, while inclined and vertical sheets can be made thinner, if well braced. Unnecessary joints and rivets should be eliminated and such a combination of flat and formed plates and structural shapes should be used in the construction as will provide the proper strength with the least amount of material used and enable the most economical maintenance on account of ordinary wear or tear and casualty.

Formed or cast steel sections built into the underframe as a body bolster and structural or cast steel truck bolsters and side frames can be combined to make a light and strong construction. The increasing severity of buffing and pulling stresses makes it necessary to materially strengthen the center sills by deep box designs and to distribute these shocks over a large area of the draft and center sills in a manner that will relieve all other parts of the under and superimposed frame of the car body from stresses that will tend to loosen the rivets and joints.

Of the various items contributing to freight car delays and failures, the couplers, coupler yokes, draft gear and attachment of same to the underframes, body and truck bolsters and the wheels and brake equipment contribute either directly or indirectly to the greatest extent. A combination of coupler, coupler yoke and draft gear of sufficient strength and elasticity to withstand the locomotive maximum draw bar pull and the punishment due to buffing shocks will, when securely attached along the center line of draft to the center sills in such a manner as to distribute the stresses at the greatest number of points and over the largest area, materially reduce the coupling difficulties.

The use of substantial body and truck bolsters that will carry the ultimate load at the center plate; of anti-frictional center plates and side bearings, and of ample lateral movement for couplers at the end sills will do much to reduce train resistance, wheel flange wear and liability for derailment. However, so long as the rail section now generally in use is continued it will be difficult to prevent rapid wheel flange wear and possibility of breakage, but a refined chilled cast iron or a one-mileage forged steel wheel with hardened flange and tread wearing surfaces would be of general benefit, if produced at a reasonable cost.

The necessity for the use of hand brakes in the controlling of freight trains on long and severe grades at speeds that will provide for the movement of the maximum business with a proper degree of safety, frequently determines the tonnage of trains both up and down grade, and a combination of air and foundation brakes, brake beam and shoe, and slack adjusting equipment that will insure maximum allowable braking power per car and place the entire control in the hands of the locomotive engineer without liability for sliding wheels, will be of material assistance in increasing the capacity of railroad lines traversing a mountainous section.

Interchangeability of Parts.—While the Master Car Builders' Association has made much progress in promulgating general practices and adopting standards of minor parts of cars, such as—wheels, axles, journal boxes and contained parts; brake beams, heads and shoes; couplers; hose; side and end doors; helical springs; foundation brake gear; safety appliances and marking—the changed conditions now make it essential that car bodies and trucks as a whole, of similar kinds and classes, shall be simplified by standard practice and made interchangeable, and it is anticipated that some final action along these lines will result from the coming meeting.

Maintenance.—The freight car of today must withstand about as much grief as the average mechanical department official. It is required to operate on 60 degree commercial track curves and over any obstacle; to withstand a 25-mile per hour impact when loaded and passing through gravity and hump yards; to be mauled and turned upside-down for dumping; to receive red-hot lading, such as billets, pig iron and slag; to resist the steam, fire and dynamite that is used to loosen frozen loads of coal, sand and ore; to submit to the corrosive action of acids, alkalis, water and weather; to retain any load that can be safely gotten into or on top of it; to endure loading by crane hoist; undergo removal of lading by clam shell, scraper or plow; to be able to lose any part of itself that may facilitate loading or unloading and to still retain its identity and return to its owners with a clear record against delay, failure or personal injury.

Therefore, it becomes necessary that the maintenance of this equipment be given adequate attention to insure it against the general operating causes for failure which consist of unsuitable distribution and use of cars that are adapted for only certain classes of commodities and service; freight improperly distributed or built up; lading beyond the allowable capacity for distributed or concentrated weight; abuse by consignors and consignees when loading and unloading; cars of light capacity and design placed at the head end of and between cars of heavier types in trains; and rough handling by yard, train and engine crews.

The number of loaded and empty system and foreign revenue freight cars (exclusive of cars in bad order condition under load at destination), held over each day (except after Sundays and legal holidays), for all classes of accident and ordinary repairs, should not exceed 3 per cent. of the total system and foreign revenue cars on the line and the repair force and material should be so regulated that no more bad order cars will be detained each day than the number repaired, every preference being given to loaded and empty cars that are in the greatest demand for the movement of the business offered.

When the earning capacity averages from $2.50 to $3.00 per day for each freight car available for service, the interest on an investment for shop facilities to adequately economize and increase the output can be readily justified. Such facilities should provide shelter from sun, rain, snow and wind for workmen employed on cars requiring heavy repairs, so that the usual increase in the proportion of bad order cars after unfavorable weather conditions will not be so marked as at present. Ample and up-to-date metal and wood working machine tools, pneumatically or electrically operated portable and hand tools and general facilities for the storage and portage of all new, second-hand and scrap material are most essential. Transfer trestles and cranes should also be installed in freight car repair yards to reduce switching, delay and expense for transferring and rebuilding lading on cars which are not in condition for movement.

Indifferent foreign cars should be put in proper repair for loading and not returned to the owners light except when generally worn out by age and decay, or unless lading is not available and a home station is close by. This practice will avoid loss due to light mileage and additional damage to the car through its movement in a defective condition.

The prompt and proper switching of cars on repair tracks is an

* Extract from a paper presented before the March meeting of the Railway Club of Fittsburgh.

† General Superintendent of Motive Power, Baltimore & Ohio Railroad.

operation that is frequently overlooked and which is usually given indifferent attention and is done at whatever time the yard switching service may find it convenient, rather than during a period when it will least interfere with the working of the forces. Many unnecessary and costly movements can be avoided by the spacing of cars when they are switched on the shop tracks so as to eliminate the delay and expense that would otherwise occur by jacking the cars apart and moving them by hand.

Certain classes of cars should be given special repair attention at those seasons of the year when the business least requires their use or when the repair forces can be worked to good advantage during daylight and favorable weather. System cars of a class and capacity which makes them desirable for five or more years' service, should, when empty and placed on shop tracks for heavy repairs, receive such renewals and betterments as will put them in a substantial condition. The repetition of classified repairs which do not permanently improve such equipment results in temporary maintenance, successive line failures and delays to traffic, and continued expense for the same class of work. Good material removed from cars that should receive heavy repairs and betterments to put them in efficient condition, can always be utilized to advantage when making lighter classes of repairs to loaded and empty cars to keep them temporarily serviceable until they can be properly reinforced.

Terminal and Interchange Inspection.—The object of the Master Car Builders' Rules is to facilitate the movement of cars in interchange service and to place the responsibility for defects which may or may not make a loaded or empty car unfit for service. However, the intent of the rules is frequently nullified through a lack of good judgment owing to the somewhat general impression that the ability of a car inspector is decided by his record as a "car stopper" rather than as a "car mover," and the holding of cars by unintelligent inspection or on technicalities at joint and interchange points, is responsible for much delay to traffic, expense for transferring lading and loss of use of equipment.

Cars set off on the line of road due to bad order condition of couplers, draft attachments, wheels or brakes; heated bearings; shifted lading and other similar causes are usually the outcome of improper inspection, repairs, adjustment or testing of brakes, lubrication and loading at originating terminals, and result in accidents, destroyed lading and cars, reduced train rating, delays to traffic, blocking of passing sidings, engine and train crew overtime and extraordinary expense for sending men and material out on the line to make repairs. The elimination of rules and inspection points which are unnecessary to maintain cars en route in a serviceable condition for operation and safe for trainmen and lading; fewer and more thoroughly trained car inspectors; agreements between connecting lines that will keep cars moving on such interchange records as will insure proper accounting for repair charges; a greater number of more competent car repairmen and more thorough attention given to equipment at the unloading and loading points will, without a doubt, reduce some of the present line delays.

The substantial building up and proper distribution of freight on single, twin and triple cars by shippers is also a detail that will do much to reduce delays to their freight between origination and destination points by eliminating the necessity for rebuilding and transferring lading or for setting out cars en route for consequential repairs due to derailments, heated bearings and similar causes.

Dismantling.—For the benefit of connecting railroads handling either interstate or intrastate traffic it is essential when a freight car of undesirable class and capacity has outlived its usefulness and reaches a shop track in such bad order due to age, decay and corrosion that the expenditure necessary to put it in serviceable condition is not justified, that it should be disposed of by dismantling rather than by sale, to insure its identity being absolutely destroyed.

Each car to be disposed of should be properly passed upon at the time that it condemns itself, rather than as a part of a general dismantling program at some predetermined period.

There is always some good material in a wooden freight car body, such as lumber, rods, bars, castings, bolts and nuts which can be utilized to advantage in repairing other cars, and the trucks, either wholly or in part, can invariably be disposed of by use under other equipment. Therefore, the destroying of cars by burning is only warranted in cases of extreme damage by accident on the line of road.

ELECTRICAL NIGHT AT THE NEW YORK RAILROAD CLUB.

The third annual electrical night of the New York Railroad Club was held on March 15th in the Engineering Societies Building. As previously announced, there was no regular technical paper presented, the meeting consisting of a series of short papers presented by electrical experts, who had been invited to speak. The subjects chosen were all to be on different phases of heavy electric traction.

The first paper was presented by Mr. W. J. Wilgus, vice-president of the New York Central Railroad, and was concerned very largely with matters in connection with the recent wreck of an electric train on that road. Mr. Wilgus stated that in view of the gross exaggerations and unjust attacks which had been made in the daily papers, and even in some of the technical papers, it would probably be of interest to discuss the actual facts of the case. He mentioned the fact that one of the electric locomotives had been given a 2½ years' test, running over 50,000 miles, on a six-mile stretch of track near Schenectady, before any of the locomotives were put in actual service. During this series of tests the locomotive had been operated at very high speeds on sharp curves without derailment or injury to the track. There had also been a series of preliminary runs made over the line on which the wreck occurred, with full weight trains, previous to the starting of the regular service.

In answer to some criticisms which had been made with reference to the use of the third rail instead of overhead construction, Mr. Wilgus pointed out that there were three reasons why overhead construction was impractical in the electric zone. One of these was that there is a clearance of but 2 in. in the Park avenue tunnel. Another was that a legislative act prohibits any additions in the way of overhead construction on the Park avenue viaduct, and the third, and most important, was the fact that the City of New York absolutely forbids the use of overhead current collection at high voltage.

The second paper presented was by Mr. George Gibbs, chief engineer of electric traction of the Pennsylvania, New York & Long Island Railroad, and gave some very interesting figures on the cost of heavy electric traction. He stated that he did not believe that engineers should be misled by the enthusiasm of the people for electricity. This paper was a most clear-cut discussion of the problem of electrifying steam railroads and will be presented in full in a future issue.

The third paper was presented by Mr. Walter C. Kerr, of Westinghouse, Church, Kerr & Co., who discussed the different methods that a steam railroad company could take in the physical work of electrifying a portion of their lines. He explained very clearly what features of advantage could be obtained by the employment of a firm of engineer-contractors whose personnel and resources could become part of the railroad company's organization for the time being.

Mr. Frank J. Sprague, who spoke next, went very carefully into the history of the electric locomotive on the New York Central Railroad, pointing out each step taken by the electric traction committee from the beginning. The point of particular interest mentioned by Mr. Sprague was the fact that bids for the locomotive equipment were received from one foreign and two American companies, the General Electric and the Westinghouse, and that the General Electric Company included in its bid a proposal for a single phase repulsion electric locomotive, but really recommended the direct current gearless locomotive. The Westinghouse Company, however, submitted no bid for alternating current locomotives, but recommended direct current locomotives of the geared type.

The next speaker was Mr. Theo. Varney, of the Westinghouse Electric and Manufacturing Company, who spoke on the devel-

opment of catenary line construction. He was followed by Mr. W. B. Potter, chief engineer of the railway department of the General Electric Company, who gave some very interesting information in connection with the experiments his company is making with gasoline electric motor cars.

The last regular speaker was Mr. Samuel Vauclain, of the Baldwin Locomotive Works, who stated that he believed the designers of electric locomotives should make use of the large amount of information which had been obtained during the development of the steam locomotive. He considered the driving wheel diameter of the electric locomotive should be as large as for a steam locomotive for the same service. He stated that it had been his suggestion that the motors of the electric locomotive should be placed in about the same space and position now occupied by the boiler of a steam locomotive and that the drive should be through a system of rods and levers. The practicability of this system has been demonstrated by the electric locomotives used in the Simplon tunnel.

At the close of the meeting the president announced that the paper for the April meeting would be by Mr. W. R. McKeen, Jr., the subject being "Gasoline Motor Cars."

THE FAILURE OF LAP JOINTS.

To the Editor:

Some time ago, at a meeting of the Western Railway Club, a representative of the Hartford Boiler Insurance Company read a paper on the subject of boiler explosions. He gave as a cause of the giving way of nine-tenths of the exploded boilers, which he had examined in his capacity as inspector, the development of a hidden crack in the single lap joint, as shown in Fig. 1, the development of this crack being due to the bending moment induced by the tension in the plate which tended to shape the

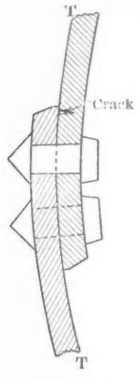


Fig. 1

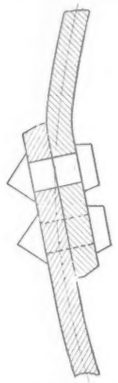


Fig. 2

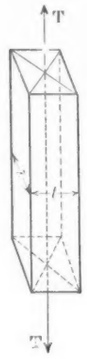


Fig. 3

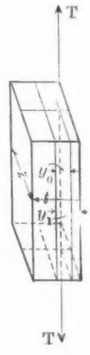


Fig. 4

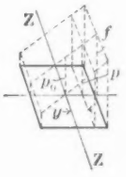


Fig. 5

center line of the cross section of the joint to that of the arc of a circle, as indicated by Fig. 2.

This idea, though not entirely new, is no doubt a true explanation of the cause of failure of many longitudinal lap joints. There is another point of view, however, from which the weakness of the lap joint may be investigated.

When designing a joint of this type it is customary to determine the stress, per unit length, to which the plate will be subjected by the formula $f = \frac{Pr}{t}$ where f = the stress per square inch, P = the boiler pressure, r = half the diameter of the boiler shell, and t = the thickness of the plate. Such a calculation is very much in error and joints so designed possess no such factor of safety as the designor intended.

Taking a strip of metal of thickness t, and width z, subjected to a tension T, the fiber stress per square inch uniformly distributed over the cross section of the strip would be $f = \frac{T}{tz}$ when the center line of action of the stress passes through the center of section of the strip, as in Fig. 3. But when the strip is subjected to an eccentric pull, the center line of action passing to one side of the center of the section, the maximum unit stress is something very different.

Let Fig. 4 represent a strip subjected to an eccentric pull. The stress on each particle may be divided into two parts, the mean stress which is always the existing stress at the center of the section, and the variable part. The mean stress balances the force T; but the moment of T about the center, or $T \times y_0$, must be balanced by the moment of the variable part of the stress taken about the axis in the plane of, and through the center of, the cross-section perpendicular to y_0.

Let P = unit stress at the point distant y from the center measured in the direction y_0 and y_1, which latter is the distance to the edge = ½ t, where the unit stress is f. If P_0 = mean unit stress found at the center, $P - P_0$ will represent the variable part found at the distance y from the center.

$$\frac{P - P_0}{f - P_0} = \frac{y}{y_1}, \text{ or } P - P_0 = \frac{f - P_0}{y_1} y.$$

If z = width of section, the moment of the variable portion of the stress about the axis Z — Z (Fig. 5) through the center will be:

$$M = \int_{-y_1}^{y_1} \frac{f - P_0}{y_1} y \, Z \, d\, y \, y$$

$$= \frac{f - P_0}{y_1} Z \int_{-y_1}^{y_1} y^2 \, d\, y$$

$$= \frac{f - P_0}{y_1} Iz$$

where Iz denotes the moment of inertia of the cross-sectional area about the axis Z — Z. This expression is the resisting moment of the cross section.

But $M = T \times y_0$ and $P_0 = \frac{T}{S}$ where $S = t \times z$ or the area of cross section of the strip.

Therefore $T \times y_0 = \left(f - \frac{T}{S}\right)\frac{Iz}{y_1}$, or $T = \frac{f\,S}{1 + \frac{y_0\, y_1\, S}{Iz}}$

$$= \frac{f\,S}{1 + \frac{y_0\, y_1}{r^2}}$$

where $r^2 = Iz \div S$ to be measured in the direction of y_1. Also

$$f = \frac{T}{S}\left(1 + \frac{y_0\, y_1}{r^2}\right) = \text{maximum unit stress due to T and } y_0.$$

Taking a circular strip of ½-in. plate 1 in. wide in a boiler 60 in. in diameter carrying 100 pounds pressure, the customary formula $f = \frac{Pr}{t}$ gives as the maximum fiber stress $\frac{100 \times 30}{½}$ = 6,000 pounds per square inch.

In the case of the lap joint the center line of action of the applied tension is at the surface of contact of the two plates, as at line T — T of Fig. 1. Applying the formula $f = \frac{T}{S}\left(1 + \frac{y_0\, y_1}{r^2}\right)$ where $y_0 = y_1 = 1/4'' =$ half the thickness of plate, the maximum fiber stress is

$$f = \frac{100 \times 30}{1/2}\left(1 + \frac{1/16}{1/48}\right)$$

$$= \frac{100 \times 30}{1/2}\ (1 + 3)$$

= 24,000 pounds.

This high stress on the extreme fiber may at first thought appear to be of no great importance since when subjected to a stress beyond the elastic limit the fiber of greatest stress would elongate there by throwing more of the stress upon those fibers in the direction of the other side of the plate. But it is an established fact that a material such as steel or iron, when subjected to a stress approaching the elastic limit, will resist such stress only a definite number of times, and when fracture does take place little or no elongation has been produced. An example of this is to be found in the breaking of axles due to the repeated tension and compression of the fiber as the axle rotates.

The actual fact that boiler plates do fail, as indicated by Fig. 1, in addition to the results as disclosed by mathematical investigation, would seem to indicate that the lap joint construction for a longitudinal boiler seam should never have been introduced in boiler practice.

In circumferential seams the conditions are not so serious since the stresses to be resisted are only half those in the longitudinal seams.

Theo. F. H. Zealand.

Illinois Central, Chicago.

Club Houses for Panama Canal Employees.—Employees on the Panama Canal are being provided with club houses in most of the villages which the Canal Commission has built. They consist of a front building of two stories, connected with a rear building of one story. The former, which is 133 x 45 ft., contains a social parlor, a card room, a billiard and a writing room on the first floor, and an assembly hall 67 x 27 ft. on the second floor. The rear building, which is 100 x 28 ft., contains double bowling alleys 100 ft. long, a gymnasium 52 ft. long, shower baths and lockers. The Commission, in conjunction with the Y. M. C. A., will manage these buidings. Each club will select a board of directors from its own membership, but all clubs will be under the control of a general board selected by the Commission. A number of buildings are also to be erected for religious services, such buildings to be available for all denominations. In some places an additional story will be added to the latter buildings, to provide lodge rooms for the various orders and societies formed among the employees.—*Engineering Record.*

Tidiness.—A few years ago a young man was given charge of a roundhouse at an out-of-the-way point on one of our large western railway lines. He was advanced from that position to the position of master mechanic, and took charge of one of the largest erecting shops on that line. In a very short time he was advanced from the position of master mechanic to assistant superintendent of motive power, and in a short time thereafter to superintendent of motive power. From that point he went east, and now holds one of the best positions in the mechanical line on any railroad in the United States. If I trace him further, I presume everyone here could mention his name. The keynote of his success was "tidiness." His roundhouse was kept clean and tidy, and as he was advanced, step by step, he did not neglect that which had called the attention of the officers of the road to him.—*Mr. J. H. Waterman before the Railway Storekeepers' Association.*

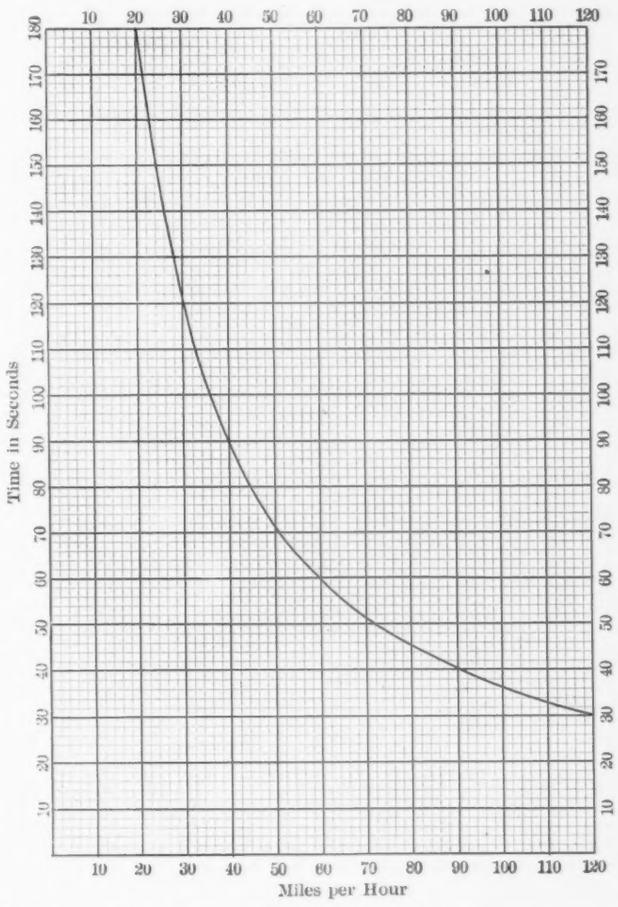
SPEED IN MILES PER HOUR

To the Editor:

Perhaps this may be new to you, perhaps not; but if it is, you will admit that it is a handy constant to store away in your memory for emergency uses.

Let speed in miles per hour be represented by "a"; time to run one mile in seconds at speed "a," by "b," and seconds in one hour by "c"—then $\frac{c}{a} = b$; $c = 3{,}600$; therefore $\frac{3{,}600}{a} = b$, or $a \times b = 3{,}600$.

In other words, the speed in miles per hour, multiplied by the



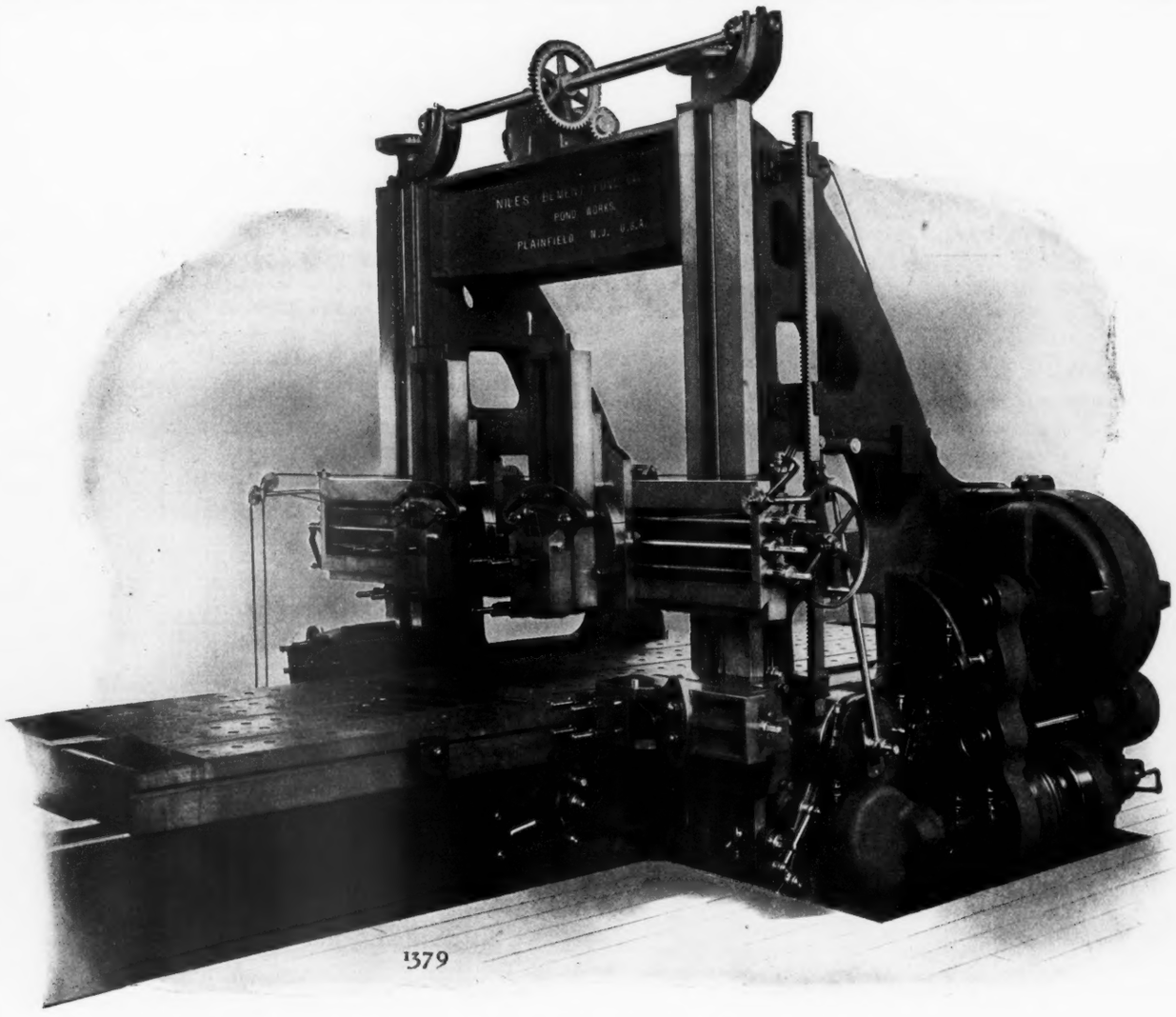
time required to run one mile at that speed in seconds, is always equal to 3,600.

The expression $a \times b = 3{,}600$ is similar to $a \times b =$ a constant, or the equation for the rectilinear hyperbolic curve representing the expansion line on an indicator diagram; and from this, the curve on the enclosed print was plotted.

W. O. Moody,
Mechanical Engineer.

Illinois Central Railroad, Chicago, Ill.

Electric Traction Not Profitable.—At the present time all the steam railroad companies that have adopted it (electric traction) are very much disappointed, suffering, as they are, considerably from the results as they have turned out as compared with the estimates given to them, and the information vouchsafed by those who were supposed to know. But every day now the cost of working electric traction is being reduced. We are not yet down to anything like the cost of steam traction, but, admittedly, it is an experimental time through which all railways, and especially the District and the Metropolitan and ourselves, are passing; and since we met last the actual cost has been considerably decreased, but we are not out of the woods yet.—*Chairman Stride of the Tilbury and Southend Ry., England.*



PNEUMATIC CLUTCH DRIVE APPLIED TO AN 84-INCH PLANER.

84 INCH PLANER WITH PNEUMATIC CLUTCHES.

The Niles-Bement-Pond Company are recommending the use of their pneumatic clutch drive on the larger size planers intended for heavy work. On such planers it is difficult to transmit sufficient power with the belt drive, since the width of the belts is limited because of the difficulty in shifting them. The pneumatic clutches will transmit any desired amount of power and it is possible to easily provide for various cutting speeds and a constant return speed.

The illustration shows one of these clutches applied to an 84 inch planer. The 55 h.p. General Electric motor is bolted to the housing and drives the clutch through gearing. If desired the clutch may be driven from an overhead counter by a wide non-shifting belt running constantly in one direction. If a constant speed motor is used variation in cutting speed may be obtained by change gears. The pneumatic clutch makes it possible to plane accurately to a given line. The diameter of the disk of the clutch shown in the illustration is 19 in.

An interesting account of the satisfactory service of one of these clutches under heavy duty was described in the March issue of the *Progress Reporter*. A 100,000 pound casting was planed on a 10 ft. Bement planer. The casting was too wide to pass between housings, and had to be finished with an extension tool clamped to one of the cross rail heads. The cutting speed was 28 feet per minute, and the return speed 78 feet per minute. The length of stroke was about 4½ feet for a period of five or six hours. The load together with table weighed 160,000 pounds.

The 84 inch planer planes 85 inches wide and 85 inches high. The table is 72 in. wide and is driven through a train of cut gearing and a rack. It may be stopped from either side of the planer without stopping the motor, and the reversing dog may be tripped, allowing the work to be run from under the tool for inspection. The bed is strengthened where the gearing and uprights are mounted, and is nearly twice the length of table. It has two V tracks, with large wearing surfaces and oil pockets with rollers for lubricating the table.

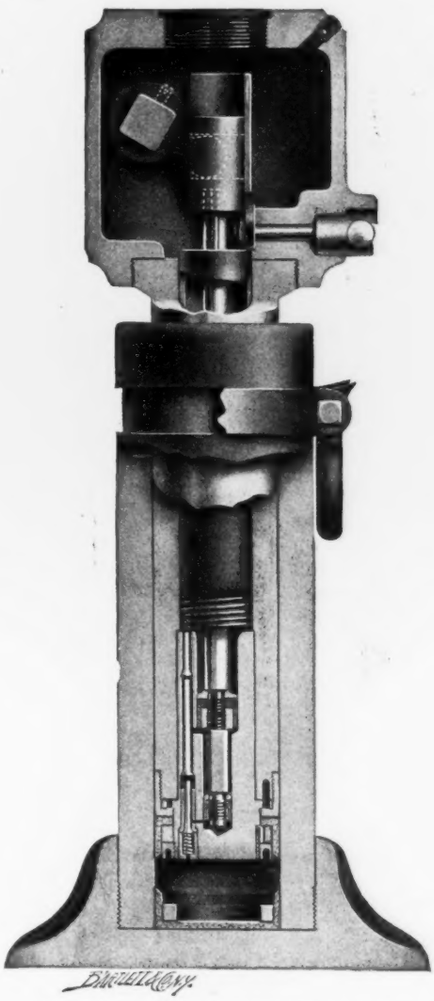
The uprights are fitted with counterbalanced, swiveling side heads with variable feed up and down the upright, driven directly by the driving gears instead of by friction. The crossrail of box form is raised by a 7½ h.p. motor; it has a deep-arched back, large wearing surfaces, taper packings for adjustment of the saddles, and sufficient length for one saddle to plane the entire width between the uprights without interfering with the other.

NECESSITY OF AMPLE REPAIR FACILITIES.—The management of the company is entirely convinced that nothing is more vital to the successful operation of a large railroad property than the provision of ample repair shop facilities, equipped with the most modern tools and labor-saving appliances for keeping in good repair locomotives and other equipment and instrumentalities required for efficient and economical operation.—*Annual Report of Pres. Truesdale, of the D. L. & W. R. R.*

SCHMIDT SUPERHEATERS.—There are at present 1,802 locomotives equipped with Schmidt superheaters in service or in course of construction. These are distributed over 60 different railways, principally in Europe.

DUDGEON UNIVERSAL HYDRAULIC JACK.

The first hydraulic jack was patented by Richard Dudgeon of New York City in 1851. The design was improved at various times, the latest and most important improvement being made in 1906. This last design, known as the "Universal," is shown in the accompanying illustration and is intended to meet the demand for a compact, light-weight hydraulic jack, easily handled, operated and controlled, and adapted to meet the requirements of the railroads for lifting heavy cars and locomotives. The method of actuating the piston rod, which passes down through the steel tube, is clearly indicated in the illustration. Under light loads the jack is operated by a double pump, which for a jack of 30 tons capacity will lift a load of 15 tons at the rate of 1 in. in every six strokes. Under heavier loads the lower



DUDGEON UNIVERSAL HYDRAULIC JACK.

pump only is used and will raise the jack at the rate of 1 in. for every 12 strokes.

The most important feature of the new design is that it requires only three valves, and they are all assembled in one chamber or passage, the two upper ones being suction valves and the lower one a pressure valve. The upper pump is cut out of action by the steel tube, which may be forced downward by the cam attached to the end of the shaft, which is operated by the handle at the lower right side of the head. When the valve handle is in the position shown, the spring just below the steel tube forces it up against the cam so that all of the valves are free to seat. When the valve handle is turned down to a vertical position the cam revolves sufficiently to force the tube downward until it comes in contact with the top of the valve stem and forces the upper valve off its seat. When in this position the liquid displaced by the upper piston simply surges back and forth through the valve. If the valve handle is turned 180 degrees from the position shown, the steel tube is forced downward far enough to unseat all three of the valves, allowing the ram to descend by its own weight. The jack may also be lowered by the lever, it being only necessary to depress the piston head until a pin projecting from the lower side of it encounters the top of the steel push tube, when it operates in the same manner as by the cam on the valve handle shaft. Any obstruction which prevents the seating of a valve can be removed by depressing the valve. If a valve should stick in its seat it can easily be pressed off. The interior parts are easy of access. The valves are reached by removing the ram and unscrewing the bonnet, when the valves with the removable seat will drop out. The piston packings are reached by unscrewing a plate in the head and lifting the piston through the opening. The jack may be operated either horizontally or vertically.

The form of base illustrated is recommended for railroad work, but a broader and heavier one can be furnished if desired. These jacks are made for various capacities, from 30 to 60 tons, by Richard Dudgeon, Broome and Columbia streets, New York City.

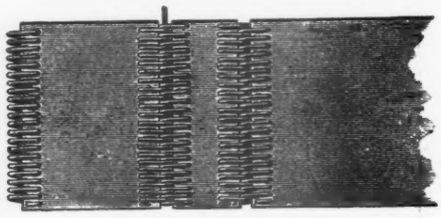
New Terminal at Hoboken.—What is stated to be the most satisfactory ferry and train terminal upon the North River was formally opened on Feb. 23 by the Delaware, Lackawanna & Western Railway. The structure has a frontage of 730 ft. on the river and includes, in addition to the ferry house, six ferry slips and a fourteen track train shed, the latter being 607 ft. in length. This shed is built with a new design of umbrella type of roof, designed by Lincoln Bush, chief engineer of the railroad, and is generally admitted to be the most perfect example of this type of train shed ever constructed in this country. It consists of a series of spans supported by a row of columns in the centre of each platform, having a narrow opening over the centre of the tracks for the escape of locomotive smoke and gases; the remainder of the span being composed largely of glass, giving an exceedingly well ventilated, light and well protected train shed. The architectural features, both interior and exterior, throughout the whole terminal, are most attractive. The station is equipped with an emergency hospital, barber shop and bath rooms, as well as a large restaurant, offices and the usual waiting rooms, smoking rooms, baggage, express, etc.

Technical Training in Altoona High School.—Through the initiative of the Pennsylvania Railroad Co. a new development in industrial education is being tried out in the Altoona High School. The industrial department of the school has received, as a gift from the Pennsylvania, equipment that places it in this respect on a par with the foremost technical schools of the second class in the United States, and far in advance of many of them. A four-year course is planned which will afford in a public school opportunities for training that have been open heretofore only to students of the technical schools. The railroad expects to secure from the high school, candidates for its shops who will enter them on a footing between that of the regular and special apprentices. The city of Altoona secures a splendidly equipped industrial school, perfectly adapted to the needs of a population, a fourth of which is employed in railroad shops, yards and offices. Altogether the new high school will cost not far from $350,000.

Ten Years' Increase.—Compared with the official returns for 1896 the figures for 1906 show the following remarkable results: Miles of line increased, 20.9 per cent.; miles of track, 31.7 per cent.; number of locomotives, 42.6 per cent.; weight of locomotives, 82.8 per cent.; number of freight cars, 51.5 per cent.; weight of freight cars, 95.3 per cent.; passengers carried one mile, 88.6 per cent.; tons of freight carried one mile, 124.3 per cent.; cars with automatic couplers, 243.1 per cent.; cars with train brakes, 265.6 per cent.; gross earnings, 101.7 per cent.; expenses of operation, 98.2 per cent.; wages of employees, 94.3 per cent.; interest and dividends, 70.5 per cent.; taxes, 72.4 per cent. In the meantime the average receipts per passenger mile have decreased 0.4 per cent. and per freight ton mile 6.9 per cent. —*Slason Thompson in recent pamphlet.*

BELT LACING MACHINE.

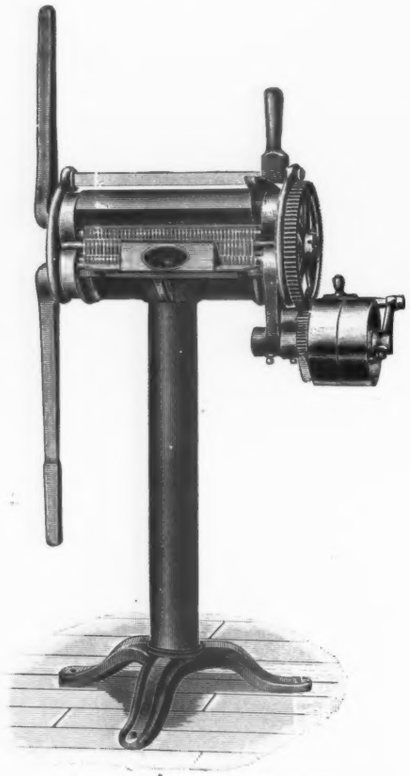
In considering the methods pursued by the Atchison, Topeka & Santa Fe Railway, whereby the expense of maintaining the belting in the shops at Topeka was reduced in less than two years from $1,000 to $275 per month and the belt failures from 300 to 55 per month (AMERICAN ENGINEER, December, 1906, page 455), mention was made of the Jackson machine lace. On the Santa Fe when a new belt is installed it is fitted with what is known as a "take-up" piece about 6 in. long. As the belt



JACKSON MACHINE LACE.

stretches this piece can readily be removed and replaced in a few minutes by a shorter one, it being only necessary to apply a clamp, withdraw the two raw-hide pins, slip out the "take-up" piece, draw the ends of the belt closer together and apply a new piece. Various lengths of these "take-up" pieces are kept in stock in the belt room, as shown in the illustration on page 456 of the December, 1906, issue.

The application of the machine lace to a piece of belting, as well as the machine for making the lace, are shown in the ac-



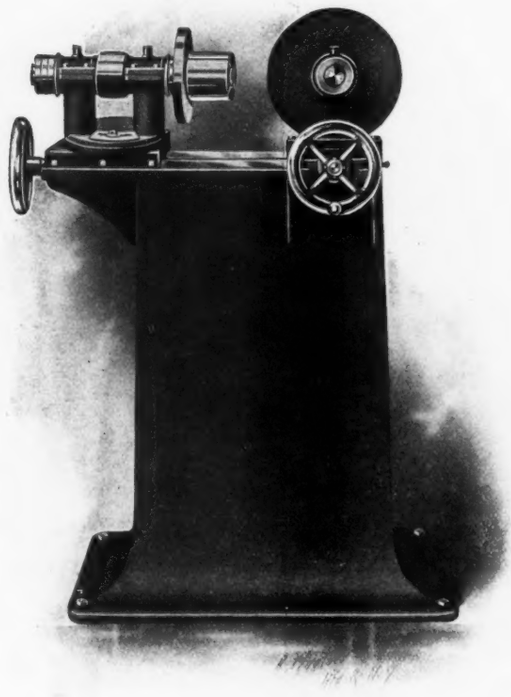
JACKSON BELT LACING MACHINE.

companying illustrations. The lacing, called the wire coil clasp lacing, is of wire and the connecting pin is of raw hide, making a strong and flexible joint. After the wire coil has been put through the end of the belt pressure is applied so that the lacing does not project beyond the face of the belt, and it, therefore, passes over the pulley noiselessly and without slipping. The cost of this lacing is said to be only about one-quarter that of the ordinary method, and it is claimed that it will last three times as long. A 6-in. belt can be laced complete in three minutes. A piece of 2½-in. belt laced in this manner stood a tensile strain of 1,900 lbs. without breaking or pulling apart.

The construction of the machine is very simple, as may be seen from the illustration; it requires only a small amount of floor space, and is comparatively inexpensive. The machines are made in four sizes to lace belt up to ½ in. in thickness and 6, 12, 18 and 24 in. in width. They are made by the Birdsboro Steel Foundry & Machine Company, Birdsboro, Pa.

SLITTER AND DISC GRINDER.

This machine, made by The Bridgeport Safety Emery Wheel Company, Bridgeport, Conn., is made with a universal chuck for grinding punches, dies, flat faces and circular pieces. The expanding arbor is opened and closed by a screw. Both heads swivel to any angle, thus enabling convex, concave or flat faces to be ground quickly. These heads are mounted on dove-tailed



BRIDGEPORT SLITTER AND DISC GRINDER.

ways, gibbed to take up wear and are fed in and out by a hand wheel and screw. The spindles on the heads are arranged with ring check nuts to take up all end play.

The machine may readily be adapted, with a few minor changes, for grinding a large variety of work. It can be equipped with a plain face plate, a Walker magnetic chuck or plain three or four jaw chucks. If desired it may be arranged for wet grinding, the wheel being enclosed with a hood and pans being placed to catch the water and conduct it back to a large tank in the base of the machine. The dirt and sediment settle to the bottom of the tank and the water is drawn from the top by a centritugal pump.

The leading dimensions are as follows:

Height from floor to center of spindle	40 in.
Length of bearings	4 in.
Diameter of spindle in bearings	1½ in.
Height from ways to center of spindle	6 in.
Diameter of face plate	7 in.
Size of wheel	10 x ½ in.
Distance between platen and wheel when new	6 in.
Weight	500 lbs.

ELECTRIC TRACTION IN ENGLAND.—Of course, electric traction will be made right in time, but at present the financial results of it are most distinctly discouraging, *e. g.*, it has reduced the Metropolitan dividend from 3 to 1 per cent., and on the District Ry. caused a deficit on working in six months of $187,000.—*Railway Engineer.*

PERSONALS

Mr. D. D. Briggs has been appointed master mechanic of the Louisville & Nashville R. R., at Montgomery, Ala.

Mr. E. A. Williams has resigned as general mechanical superintendent of the Erie R. R., and the office has been abolished.

Mr. J. E. Holtz has resigned as master mechanic of the Chicago, Rock Island & Gulf Ry., at Fort Worth, Tex.

Mr. P. J. Colligan has been appointed acting master mechanic of the Chicago, Rock Island & Gulf Ry., at Ft. Worth, Tex.

Mr. J. Schumacher has been appointed master mechanic of the Missouri Pacific Ry. at Ferriday, La., in place of Mr. R. W. Ruffner.

Mr. B. Donahue has been appointed master mechanic of the Missouri Pacific Ry. at Van Buren, Ark., to succeed Mr. F. K. Tutt.

Mr. F. K. Tutt has been appointed master mechanic of the Missouri Pacific Ry. at Osawatomie, Kan., succeeding Mr. W. B. Gaskins, resigned.

Mr. R. W. Burnett has been appointed asst. master car builder of the Can. Pac. Ry. lines east of Port Arthur, succeeding Mr. S. King, resigned.

Mr. I. W. Smith has been appointed master mechanic of the Great Northern Railway at Crookston, Minn., in place of Mr. R. H. Smith, transferred.

Mr. James N. Weaver, formerly for 20 years master mechanic of the Lehigh Valley R. R., at Sayre, Pa., died at his home in that city on February 13.

Mr. J. J. Flynn, general foreman of shops of the Louisville & Nashville R. R., at Mobile, Ala., has been appointed master mechanic at Nashville, Tenn.

Mr. F. P. Mooney has been appointed master mechanic of the Trinity & Brazos Valley Ry., with headquarters at Teague, Tex., succeeding Mr. W. C. Burel, resigned.

Mr. Warren Fogwell and Mr. D. F. Gonware have been appointed road foremen of engines of the Wabash R. R., at Decatur, Ill., succeeding Mr. J. S. Sweeney, resigned.

Mr. C. Gifford, master mechanic of the Louisville & Nashville R. R., at Montgomery, Ala., has been appointed master mechanic at Mobile, Ala., succeeding Mr. H. M. Minto, resigned.

Mr. R. W. Shultz, of Albany, N. Y., has been appointed general car foreman of the shops of the Atchison, Topeka & Santa Fe Ry., at Cleburne, Texas; vice Mr. D. W. Rasly, resigned.

Mr. R. B. Watson has been appointed engineer of tests of the Erie R. R. and the New York, Susquehanna & Western Ry., with office at Meadville, Pa., succeeding Mr. J. G. Platt, resigned.

Mr. John S. Lentz, master car builder of the Lehigh Valley R. R., with headquarters at Packerton, Pa., has been given jurisdiction of car repairs and shops over the entire Lehigh Valley system.

Mr. G. M. Ellsworth has been appointed chief motive power clerk of the Pennsylvania R. R., and Mr. O. A. Cherry has been appointed assistant chief motive power clerk, with headquarters at Altoona, Pa.

Mr. W. J. Haynen, shop superintendent of the Pere Marquette Ry., at Wyoming, Mich., and formerly master mechanic of the Detroit, Toledo & Ironton Ry., has been appointed superintendent of motive power of the Mississippi Central Ry., with office at Hattiesburg, Miss.

Mr. James Ogilvie, superintendent of motive power of the Ottawa Division of the Grand Trunk Ry., has been recommended by the Board of Railway Commissioners to the Canadian Government for appointment as inspector of rolling stock and general equipment of Canadian railways.

Mr. H. H. Hale, formerly assistant master mechanic of the Pere Marquette Ry., at Grand Rapids, Mich., has been appointed superintendent of motive power and consulting engineer of the Nevada R. R. and the Nevada Consolidated Mining & Milling Co., with headquarters at San Francisco.

Mr. Harrington Emerson has been appointed standardizing engineer of the American Locomotive Co., with office at 111 Broadway, New York. He will report to the vice-president in charge of manufacturing, and has authority to investigate and recommend standard methods of shop operation, shop accounting and handling material.

Mr. Harry C. Hoeſinghoff, president and general manager of the Bickford Drill & Tool Company, Cincinnati, Ohio, died March 2. He was 35 years of age and had been president of the company since 1899, when he succeeded his father. The company has grown rapidly and been very successful under his administration, and his loss will be felt not only by it but by the machine tool builders' fraternity at large, of which he was a very prominent member.

ESTIMATING LOCOMOTIVE SPEED.—A simple way to arrive at the speed on the hard pulls when a train is moving slowly, is to count the number of exhausts for ten seconds. If this is done, and the diameter of the drivers outside of tires is known, the speed in M. P. H. can be accurately found by multiplying the diameter of the drivers in inches by the exhausts in ten seconds and dividing by 225.—*Mr. C. D. Buell, before the Traveling Engineers' Association.*

BOOKS

Statistics of Railways in the United States, 1905. Report of the Interstate Commerce Commission. Government Printing Office, Washington, D. C.

This is the yearly report of the Interstate Commerce Commission and contains about 700 pages of statistics of all kinds on the railways of the United States.

Watts Official Railway Guide. Published monthly by the Watts Publishing Company, Atlanta, Ga. Subscription price, $2.00 per year.

It contains railway time schedules, connections and distances; hotel directory, shipping and postal guide; gives all railway stations and principal towns, together with the population and other information for the Southern States. The publication is now entering upon its 22nd year and will be found of much value to travelers in that section of the country.

Up-to-Date Air Brake Catechism. By Robert H. Blackall. 21st edition, revised and enlarged. Published by the Norman W. Henley Publishing Company, 132 Nassau street, New York. Price, $2.00.

A new edition of this well-known work which has again been brought "up to date" has just been finished. The addition of an appendix which fully describes the improved air brake devices which have appeared since the revision was finished brings the subjects strictly up to the date of going to press. The whole work has been completely revised in all parts and is undoubtedly the best book on the Westinghouse air brake obtainable to-day.

Questions and Answers from The Gas Engine. 275 pages. 5 by 7. Cloth. Published by the Gas Engine Publishing Company, Cincinnati, Ohio. Price, $1.50.

This book has been compiled from the "Answers and Inquiries" column in *The Gas Engine*, and contains answers to questions relating to the design, construction, operation and repair of gas and gasoline engines for stationary, marine and automobile use. These answers have been made by some of the best recognized authorities on the subjects in both America and Europe, and will be found to very completely cover the field. A complete index is included, permitting rapid reference to any desired subject.

Railroad Pocket Book. By Fred H. Colvin. Bound in flexible cloth. 4 by 6. Published by the Derry-Collard Company, 109 Liberty St., New York. Price, $1.00.

This book has been prepared to give in a convenient form, information which is constantly being required in all different branches of railroad

service. It gives a vast amount of such information in a brief and clear manner and in a handy form. The whole book is alphabetically arranged and is practically an encyclopedia of railroad matters boiled down into pocket book form. Matter is included for all different departments and illustration are given wherever needed. The mechanical department has been well taken care of in this work, which includes not only much matter obtainable in other places, such as M. C. B. and M. M. standards, but also a large amount of information which is not readily available to the ordinary man, as for instance, the cost of stopping trains, coal consumption, analysis of different coals, etc. This work is to be highly recommended and will no doubt prove, after a brief trial, to be practically invaluable to its possessor.

CATALOGS

IN WRITING FOR THESE CATALOGS PLEASE MENTION THIS JOURNAL.

SECOND-HAND MACHINE TOOLS.—The Niles-Bement-Pond Company is sending out list No. 13 containing descriptions of 294 second-hand metal-working machine tools of all kinds which they have for sale. Copies may be had by addressing the company at 111 Broadway, New York City.

STORAGE BATTERIES.—The Willard Storage Battery Co., Cleveland, Ohio, is issuing a catalog which illustrates and gives complete data on several different types of portable storage batteries which have been developed after many years of experience in this business. Complete data, together with prices of complete apparatus and parts, is given for each type.

VERTICAL ENCLOSED FAN ENGINES.—A revised edition of Bulletin No. 125 in the Sturtevant Engineering Series has just been issued by the B. F. Sturtevant Company, of Boston, Mass. It describes the line of vertical forced-lubrication enclosed engines which this company manufactures in eighteen different sizes, ranging from 5 x 5 to 12 x 10 in. A sectional view makes clear the method of positive lubrication.

COAL AND ASH HANDLING.—The Jeffrey Manufacturing Co., Columbus, Ohio, is issuing a pamphlet devoted largely to illustrations of several recent installations of coal and ash handling apparatus. Most of them employ grab buckets handled by a jib or traveling crane. Cross sections of typical power houses are an interesting part of the pamphlet. Another pamphlet being issued by the same company shows the application of the traveling bucket conveyor for the same purposes.

THE BUSINESS BOOMER.—S. F. Bowser & Co. are making a practice of issuing twice a month a pamphlet entitled "The Bowser Business Boomer." A recent issue contains a primer, which, while written particularly for the Bowser salesmen, is applicable to almost any line of business. The Boomer is issued in the interests of the selling force of the company, which now numbers nearly 2,000 men, and contains much of a humorous, personal nature, as well as good advice for obtaining new business.

LOCOMOTIVE SANDERS.—The American Locomotive Sander Company, Philadelphia and Chicago, is issuing a very attractive catalog illustrating and describing the several different designs of Leach and "She" air sanders. These are shown in single, double and triple designs, the apparatus in each case being clearly shown by phantom and sectional views, as well as illustrations of detail parts giving the proper name for ordering. An arrangement for automatic sanding in connection with the engineer's air brake valve is also shown.

GASOLINE STORAGE TANKS AND PUMPS FOR AUTOMOBILES.—S. F. Bowser & Co., Ft. Wayne, Ind., is prepared to furnish several different designs and arrangements of underground tanks and connecting pumps for the storage of gasoline in the garage, and are issuing a catalog which illustrates and describes them. Designs are shown with both self-measuring and other types of pumps for either long or short distance service. In all cases the tank is buried in the ground and when once put into the tank, the gasoline is not exposed to the air at any time until it reaches the carbureter. Several different designs of tanks and pumps for storage of lubricating oils for automobiles are also shown.

IN THE MAINE WOODS.—The Bangor & Aroostook Railroad, Mr. George H. Houghton, passenger traffic manager, Bangor, Me., is issuing a magazine with the above title. This contains over 130 pages of reading matter profusely illustrated with photographic views of hunting and fishing scenes in the Maine woods, a number of which are colored. The articles are based on life in the woods, being both interesting and instructive. Following the reading matter there are over 70 pages of advertising, which includes a large number of camps and hotels in different parts of Maine, in most cases showing views of the quarters. This book will be found to be most interesting to anyone interested in woods life.

ELECTRICAL APPARATUS.—The General Electric Company is issuing a number of new bulletins which include numbers on the following subjects: No. 4485 gives a brief description and line drawings of portable gasoline engine and generator outfits. No. 4490 briefly describes portable air compressor sets, which contain motor, compressor and storage tanks mounted on a three-wheel truck. No. 4489 is on crane wiring supplies. No. 4492 is on small plant alternating current switchboards. No. 4487 is on small plant continuous current switchboard panels. No. 4488, which supersedes No. 4415, is on the Thompson recording wattmeter. No. 4491, which supersedes No. 4369, is a very completely illustrated catalog of controllers for power and mining service.

LIGHT LOCOMOTIVES.—A pamphlet recently issued by the American Locomotive Company illustrates and describes light locomotives, both steam and compressed air, adapted for the use of contractors, mines, logging roads, plantations and industrial plants and for a wide range of service on light rails and poor roadbed. The pamphlet contains 31 illustrations of different designs and types, and on the page opposite each illustration is a table giving the principal dimensions of designs, of progressive weights and hauling capacities of the type illustrated. The last part of the pamphlet is devoted to engineering data and contains a number of very useful tables and formulæ.

CRUCIBLES.—The Joseph Dixon Crucible Co., Jersey City, N. J., has published a very attractive pamphlet on graphite crucibles, their care and use. The author of this work is Mr. John A. Walker, vice-president and general manager of the company, who is fitted by his forty years' service in this field to speak as an authority on the subject. The purpose of the book is to instruct users of crucibles as to their proper care and the dangers of abuse. Most crucibles are perfect when they reach the user and their failure, in practically all cases, is due to ignorance of the proper method of handling. Rules are given for annealing and a word as to its importance; how to put the metal in the crucible; how to put the crucible in the fire; what sort of fuel to use, etc. The pamphlet also contains tables showing the make-up of the principal alloys; the freezing, fusing and boiling points of certain materials and other general information useful in foundry work. A double page colored picture in the center of the book shows a most realistic and vivid foundry scene. The book is profusely illustrated and will be found to be of much value to the users of crucibles.

NOTES

QUINCY-MANCHESTER-SARGENT COMPANY.—This company announces that after April 1 the machinery sales department will be removed from Plainfield, N. J., to the new West Street Building, No. 90 West street, New York City.

AMERICAN STEAM GAUGE & VALVE MFG. COMPANY.—The Chicago office of the above company, which for the past 20 years has been located at No. 16 N. Canal street, has been removed to No. 7 South Jefferson street, where much larger quarters have been leased. This will allow this office to carry a much larger stock than has heretofore been possible.

AMERICAN BLOWER COMPANY.—This company has just finished a large addition to its steel plate fan shop and is planning on a large addition to the power plant and also to the engine construction department. It is stated that business is growing so rapidly that it is with difficulty that the continual increase in size of the plant can be made to keep up with the output demanded.

SAFETY CAR HEATING & LIGHTING COMPANY.—This company announces the removal of its general offices from 160 Broadway to the new United States Express Building on the corner of Trinity Place and Rector street, New York. It has leased the entire seventeenth floor of that building. Announcement is also made of the appointment of Mr. W. L. Garland as general agent of the company at Philadelphia, Pa.

INDEPENDENT PNEUMATIC TOOL COMPANY.—This company reports that it has received a large order for Thor piston air drills, and pneumatic hammers from the Wisconsin Engine Company, which was placed only after an exhaustive test of practically every make of pneumatic tool on the market, lasting about three months. It is stated that the Thor tools showed greater efficiency and durability than any others in the competition.

PINTSCH GAS LAMPS IN GERMANY.—The Directors of the Prussian State Railways have decided to change the lighting equipment of all cars on its lines to the incandescent gas lighting system, which change will be effective before the end of 1909, after which date they will manufacture only Pintsch gas and not Pintsch gas enriched with acetylene as is at present used. All new cars built during 1907, to the number of about 3,800, will be equipped with the new mantle lamps.

RECENT ELECTRICAL EQUIPMENT IN RAILROAD SHOPS.—The Western Maryland Railroad in its new division shops at Hagerstown, Md., has installed one 150 kw. and one 250 kw. Allis-Chalmers direct current generator, together with a small motor generator set, for furnishing power to drive the shop tools and light the shops and terminal. The Norfolk & Western Railway are also installing Allis-Chalmers alternators, one of 175 kw. and one of 150 kw., for carrying the motor and lighting load of its shops at Bluefields, W. Va.

PITTSBURG STEEL COMPANY.—This company, which is the largest independent steel manufacturing concern in the country, will build a $7,000,000 addition to its plant at Monessen, Pa., which will include two new blast furnaces, a blooming mill and an open hearth furnace. The company has also recently secured some valuable ore lands, and it is stated that at the expiration of its contract with the United States Steel Corporation, two years hence, it will be able to make its own steel billets, these now being secured from the steel corporation. The new blast furnaces, etc., will make the Monessen plant one of the best in the country and will enable it to enter into competition for contracts of large size for cold drawn steel, the manufacture of which is at present confined almost entirely to the steel corporation. The new plant will have excellent transportation facilities by both water and rail.